JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

EDITOR & PUBLISHER: WALTER KING. OFFICE: 11, BOLT COURT, FLEET ST., LONDON.

VOL. CII., No. 2354.—TUESDAY, JUNE 23, 1908.

EDITORIAL NOTES—GAS, &c.

The Institution Meeting.

"A GREAT SUCCESS" is the verdict of all who were fortunately able to attend the meeting of the Institution of Gas Engineers in London last week; and the President (Mr. W. Doig Gibb) and all who had part officially or by contribution to the proceedings have reward in the knowledge of unanimous appreciation. The President himself fulfilled completely the high expectations formed by those who honoured him, by conferring upon him the highest dignity the Institution can bestow, not only for his professional qualifications but for those personal attributes that have attached to him such a number of friends in the gas industry. Both on the technical and the social sides, the meeting has indeed been a memorable one. The latter years of the old century and the opening years of the new constitute an era in the history of the gas industry that will stand out in all time as remarkable for constructiveness, progress, and change. Something of this was seen in the papers that were read during the meeting. The lecture by Professor W. A. Bone, F.R.S., of Leeds University, was also composed largely of the fruit of much original labour, shedding new light on the changes that take place by the action of heat on the hydrocarbons methane, ethane, ethylene, and acetylene; and it emphasizes the importance of keeping gas, during the period of its evolution from coal, as far as is practicable from contact with the heated surfaces of retorts. The decomposition of methane into its elements carbon and hydrogen increasingly proceeds with advancing temperatures. This does not occur in the gas itself, but only where the latter comes in contact with heated solid surfaces, on which the carbon is deposited as a hard, dense, lustrous mass, exactly resembling retort carbon. More on this subject is to be found in our "Review" of the proceedings. Having regard, however, to the salient features of the meeting it will be admitted that our appreciation of its character is not placed one whit too high.

The President's Address.

"MANNERISM is pardonable, and is sometimes even agree-"able, when the manner is natural," wrote Macaulay in one of his essays. The President's address was full of individuality, the characteristic of caution prevailed in most parts, controversial matters were touched upon, but generally in a non-committal manner, except in certain of the common phases of gas-engineering practice, but withal it was "agree-"able," and the manner was natural. There was no attempt in the address to produce something that savours of that conceit in literary composition against which that versatile writer—Thomas Newbigging—effectively tilted in one of his choice and thoughtful lucubrations. It was a survey of contemporary professional fashion and action, couched in plain language, but here and there, very naturally, from the point of view of engineers controlling works of such magnitude as those of the Newcastle and Gateshead Gas Company. Though the President is by no means an altitudinarian, in some places what he had to say was beyond the province of the engineer of smaller works. But this is unavoidable in any Presidential Address to such a body as the Institution. Taking, however, the address as a whole, it shows how in the administrative and the commercial fields of the industry's work, change has come, has been met, and there is knowledge of still more in store; and of how in the constructive and technical field, we are standing in cross roads, hesitating and waiting for the finger of research and practice to point us the road that may be followed with the assurance of success. Optimism is a characteristic of the President; it infuses his address. No sceptic philosophy has part in his thought and consideration regarding the present and future of the industry. Sufficient for him that the industry has withstood the severest of shocks on both its commercial and technical sides—and progresses; and therefore that the supervening difficulties can be met with tranquil spirit, if the manner of meeting them be robust. Though caution prevails on controversial points, through the President's belief that *ex cathedra* utterances should be free from the *dicta* of partizanship and from the ideas formed through individual condition in professional position and scene of active work, there are several sidelights in the address by means of which it is easy to trace personal conviction and opinion.

Let us glance at points of the address. There is one phase of our industrial interests, lying on the side of the commercial, upon which Presidents can always descant. That is the unbroken record of the progress of the gas industry. Competition, active and callous, has come, and has made headway, even to financial success. The gas industry progresses. Incandescent gas lighting has come, and has been largely adopted; scientific aid in heating and industrial application has produced greater efficiency; and there has been economy against the gas supplier as seller, but to his advantage through the benefit to the interests of the consumers. The gas industry progresses. The business-reducing factors have been met by broadening use and an expansion of base. The recuperative power of the industry has indeed been one of the marvels of those who knew it thirty, forty, and fifty years ago, and who are with us to-day to make the comparison. If in their early days, they could have foretold what the industry would have to meet, without being aware of the advantages also in store, they would have spoken of lowering skies and of murky prospects. But the skies of the industry are still as open as ever; the prospects as bright. Competition has found its level; and the consumption-reducing factors of improving advance have now diminishing effect. Increased competition, all will agree with the President, has not been without its benefits. But we are not yet prepared to admit that those who conduct the campaign on behalf of our electrical and chief competitor have yet learnt the futility of attempted gross defamation of a well-established character. They have dropped the comparison—senseless and puerile—of electric lamps with flat-flame gas-burners; but they have taken up new lines of attack, without thought of, or credit to, concurrent progress in the means of utilizing gas. The vanity of mistaken superiority has led them in their propaganda media, into a maze of exaggeration, through which the experienced consumer of gas by modern methods finds no difficulty in seeing clearly, and has also led them into statements which reflect upon the intelligence and competence of the householder to form independent judgment. These modes of competition have, in our belief, recoiled upon the electricians to the advantage of the gas industry. Nevertheless, we do not yet look for a more enlightened manner of proceeding. Circumstances are pushing the electricians into extremities for disposing of a larger proportion of electricity for lighting purposes; and therefore, while the President does not anticipate quite such fierce competition in the future, we rather think that circumstances will accelerate energy in endeavouring to develop the electric lighting business. If present circumstances have not that effect, then the electric lighting business has before it some very dark days.

Scrutinizing the gas industry's commercial position, moved the President to remark upon how commercial success in the disposing of gas has a marked effect upon a point of finance. The peaks of the gas consumption curve were at one time high and pointed; the incandescent gas-burner has been one means of curtailing the rapid ascent of these peaks. Coincidently, the day load has been rising apace; and thus, while the volume of business has been expanding, there has not been the old necessity for spending additional capital for providing plant for the sole purpose of meeting the peak loads of consumption. This, too, has had a gradual influence on the capital expenditure per million feet of output. To the advantage of the industry is all this; and there are signs that this satisfactory trend to enhanced stability will continue

uninterruptedly. The prediction may here be ventured that this will, if we apportion the capital expenditure to the various sections of a gas-works manufacturing and distributing plant, be as clearly noticeable in the retort-house plant as in other part, taken per unit of output; for with the building up of the summer and day consumption, the raising and the lowering of the old lines of erratic demand upon the retort plant, the increase in the size of the units of plant that can be constantly employed, and moreover the greater efficiency of such plants, and the obtaining from them of a greater yield per ton of coal carbonized—in which respect the ultimate point has not yet been defined—all show that in this direction, as well as others in manufacturing and distributing plant, the capital expenditure will hereafter be still more remunerative.

Concerning the work that is proceeding in carbonizing, the President declined to pronounce an opinion as to any superior merit in any one direction; but it was a philosophic remark which fell from him, and which shows the turmoil of ideas and ideals, that never was there a time when the engineer who has to design new works is more puzzled to know what to do than at the present. The sanguine temperament of the President permits him to believe that the report of the Institution Sub-Committee on Carbonizing will simplify the task of the engineer in designing his retort-settings. We hope that it may. But we are not so sure that it will. The report will, if we mistake not—and if it does not, there will be disappointment—bring before us the points to aim at in carbonizing practice, and how individually they have been attained in retort structures and method; it will also tell us of the points to be avoided, and how they have been avoided in individual cases. But how to compact all the good, and entirely shun the bad, in one retort-setting will be a matter that will give perplexity to many an engineer after the Committee's report is issued. We have here a side light on the inclination of the President's opinion from observation. He is without doubt hopeful that from the work there will eventuate a process of continuous carbonization, with as little machinery as possible, and that little simple and reliable. He also believes that, in future, outside producers will be a system common to retort installations. That is a controversial matter; but this can be said that the continuous working of larger units of carbonizing plant makes their application more feasible to-day in many works where they could not have been contemplated before.

A section of the address in which the President throws new light on an old subject is that wherein he deals with large capacity railway waggons. As an engineer, he advises a more generous consideration in the construction of works' overhead railway lines and sidings generally, so as to be prepared for the new stresses and conditions that accompany the use of larger capacity waggons. Adoption of such trucks is somewhat handicapped by the prevailing circumstances of the railway companies in the matter of equipment; but there are economical considerations that cannot be avoided —not even by the railway companies, though with them, in these competitive days and with revenue being eaten into with greater vigour than can be looked upon composedly, expediency and capital expenditure have to be compared very critically with tangible advantage. There are, however, figures in the address, worked out by the President, which indicate that between the use of 10 and 40 ton trucks there is a saving in the length of a train to carry the same weight of coal of nearly one-half, and that the dead-load to be moved by the engine is reduced by close upon a third. This opens up a vista of economy, from the one standpoint; but it is a subject on which it would be of the greatest interest to hear a discussion between railway and gas engineers.

The fringes of many other topics were touched by the President. He mentioned among other matters the claims of Herr Walther Feld for his methods of recovering bye-products from coal gas separately or in concentrated form. The President refrained from certifying the validity of all the claims, though he vouched for the extreme ingenuity embodied in the special washer that Herr Feld has designed to do most of the work, and which has helped towards the ideal condition of continuous purification *in situ*. There is a proneness to scepticism when such a bunch of benefits as Herr Feld offers is placed before one, challenging in a single move the cherished theories and practices of years; and nothing but the evidence of revelation from practice will induce any complete belief. There is this, however, to be said, that Herr Feld's claims have attracted the attention of many specialists, including British; and scepticism among them has been turned to giving his processes credit for offering great promise. But there is as yet scant evidence from practical trial. After the President's testimony as to the saving to be effected by motor waggons for the carriage of bulk loads, there will be a larger consideration of this subject than ever before. Coal testing is another controversial subject upon which the President dilated with the knowledge that comes from experience. Though at present he employs the 2·24 lbs. test, the vagaries of comparative result have turned his favour to a test plant that more approaches actual working conditions. It is undoubtedly a strong point that he makes that the thickest seams of gas coal having been largely worked out, there is now a greater variation of quality in the bulk than formerly; and therefore that the 2·24-lbs. charge, or even an average of a number of such charges, does not give reliable results. This suggests yet another point, that the published tests of coal for gas-making purposes sadly require revision. They were mostly made under conditions of carbonizing that were altogether different from those obtaining to-day, and at a time when, generally speaking, a more uniform quality of gas coal was available.

Some sound and informative remarks were also submitted by the President on the question of high-pressure distribution. They must be passed with this mere reference, to leave room for a few words on the training of gas engineers. We are in total agreement with him that the college workshop training can never, nor should be expected to, replace the practical experience of the works' shops. In no branch of engineering, however, is such a round of accomplishments necessary as in that of gas engineering and works' management; and our belief therefore is that, where opportunity allows, the rudimentary training before the practical work should be as broad as possible. There are colleges and colleges; and the choice of a college is most important. Where a student has been privileged in being trained at a college of proved good repute, he enters on his practical training in the works' shops with a knowledge of the why and the wherefore of what he is doing. He has, through that knowledge, a definite advantage over the pupil whom opportunity has not favoured in the same manner, and who possibly builds round his practical work a heap of misconception through ignorance of principles, that only long years can eradicate. It is interesting to hear men talk of practical work first, and the cultivation of a knowledge of principles after. Is a child taught composition, before the alphabet is mastered?

One word more before leaving this subject and the address. The President has been appointed Examiner in Gas Engineering to the City and Guilds of London Institute. It is hoped that, in preparing the papers for the examination, he will endeavour to, in a measure, put himself in the shoes of the candidates, and not examine them as he would a man with a life-long experience at his back.

Carbonization in Vertical Retorts.

The technical literature of the gas industry has been considerably enriched by this meeting; and, as has been remarked in the opening reference, the proceedings are unique in the annals of gas organizations. One fact would make them so. This is the first occasion that the intermittent and the continuous systems of carbonizing in vertical retorts have been brought forward at one time, on one platform, and before one body of professional gas men for their critical judgment; and what has come of it, as between the two systems? Nothing. Analyze the two papers and the report of the emissaries of the Carbonization Committee to Dessau, take out and systematically place the advantages of the two systems side by side, examine them with an unprejudiced eye, and so far as the results go—having regard to the coal carbonized, and eliminating the results of working in which steam has been used so as to get as comparable figures as possible—there is still unpublished sufficient evidence to enable anyone to come to a definite conclusion as to any superior advantage to the gas maker of one system over the other. Taking figures and incontestably proved facts as advanced by Mr. A. F. P. Hayman, as the exponent on this occasion of the Dessau intermittent system, the report of Dr. Harold G. Colman and Mr. A. E. Broadberry on the results of their special tests with the retorts at Dessau, and the figures put forward by Mr. Harold W. Woodall for the Woodall-Duckham working, they all show several important advantages, which have intrinsic and monetary value, over the horizontal and inclined systems of working as

commonly practised, but which advantages may possibly yet be partially discounted by the old systems of working through adopting heavier charges, reducing the free space in the retorts, and by governing the conditions existing in the retorts, and perhaps still more so by the Guildford method of operating. We have not, however, yet got to the bottom of the facts as to the price that has to be paid for securing the benefits that the vertical system—intermittent or continuous—do present in contrast with ordinary working.

Herr Körting has already published figures that help in some measure to test what that price is so far as the Dessau system is concerned; but we are still waiting for fuller comparative figures for the continuous system. These figures refer to total working costs and capital charges; but at best they could only be estimates for the present until installations on a larger scale than those already in existence have been erected. Here, again, in relation to capital cost, as between system and system, there can be no comparison, as Mr. Broadberry points out, on the basis of per retort or per setting, but it must be on productive capacity per twenty-four hours, as it is—cannot we say conclusively?—settled that, per foot run of retort, the continuous system is the more productive of the two. There is nothing to be gained by being secretive on these points. We are engaged in an industry in which professionalism and commercialism are so entwined as to be inseparable; and the commercial aspects, as well as quantitative and qualitative results, are considerations that appeal to men whose position demands that product and advantages shall be weighed, and weighed carefully, against the total costs of production. All that is required are approximate figures, which all business men will understand are subject to variation according to location, environment, and size. It is fully appreciated that, in dealing with the complex problem of continuous carbonization, Messrs. Woodall and Duckham took in hand a task of a magnitude far exceeding anything our friends in Germany have attempted. They have been treading unbeaten tracks; and the honour that they have brought upon themselves is such that, whatever the fate of their system, the history of the distillation of coal for the production of gas can now never be written without an appreciation of the value of their important and earnest work. Their difficulties have been purely mechanical; and the *bête noire* has been found at the coke-extraction end of the retort. But now even that has been conquered—the death-knell of the bottom conveyor has been sounded; and the new and simplified coke extractor has, if we read the paper correctly, surmounted all difficulty. The best friends of Messrs. Woodall and Duckham, in view of the confidence these inventors and workers possess, will be those who urge them, as we most sincerely urge them, to come out now still more into the open. There is plenty of precedent for this from Germany.

If all the results that were published at this meeting from the intermittent and continuous systems are tabulated by readers, making allowances for the differences in the character of the coal used, it will be seen that there are figures—for instance, those of Dr. Colman and Mr. Broadberry for Dessau and the Nine Elms figures for the Woodall-Duckham system—showing approximate productions per ton between the two systems without the use of steam, and, under such conditions, there are also figures that show almost equivalent illuminating powers. There is one exception, and that is the ten-day run at Poole, when an average make per ton of 14,165 cubic feet of 14·26-candle gas was obtained. But this figure must be accepted with reserve until there is confirmation. It is perfectly clear, however, that, under existing statutory restriction in this country, any adoption of the Dessau system here would distinctly have to be accompanied by an absolute rejection of steaming, or only to the modest extent followed by Dr. Colman and Mr. Broadberry in their tests at Dessau, in which, using new Pelton coal, by steaming they reached an additional production of 400 cubic feet per ton (or a total of 11,680 cubic feet), by reducing the illuminating power by 1 candle, making it 15·37 candles. They could, however, possibly have carried the make up to 12,000 cubic feet, and yet have produced a gas that would well conform with the modern testing conditions. Respecting calorific power, there is a somewhat remarkable concordance between the figures from intermittent and continuous working; and the data from Germany are bent on breaking down quite a recently existing notion that there is something of a *pari passu* declension of calorific power with descent in illuminating power. With copious steaming at Mariendorf, one set of figures shows us, the make was run up from 11,375 cubic feet to 13,707 cubic feet per ton of coal, the illuminating power was broken down from 15·87 candles to 11·89 candles, but the calorific power only dropped from 601 to 551 B.Th.U.

All the figures as to heating value, even with heavy steaming, show the gas to be quite good enough for present-day uses. And the gas from the Dessau system, whether there is steaming or otherwise, contains a less percentage of gas useless to the consumer than is commonly the case in high makes in ordinary working. The percentages of nitrogen are low; only ranging from 1·10 to 4 in different sets of results from different installations. This is a point that Dr. Colman particularly emphasized at the meeting; and it has been referred to on previous occasions in these columns. Dr. Colman alluded to a fairly common figure of 9 per cent. of nitrogen in the gas from horizontal and inclined working; and he could doubtless have quoted cases running up to 16 and 17 per cent. There is only one analysis of the gas from the continuous system given in Mr. Woodall's paper—that of the Nine Elms gas; and there the percentage of nitrogen is 6·32. It would be interesting if he could give us the percentage of nitrogen in the gas from the Poole working, when an average production of 14,165 cubic feet per ton was obtained. Of course, the higher the percentage of nitrogen in the gas, the less the proportion of useful gas sold to the consumers; and the Dessau system, till more data from the continuous system are forthcoming, undoubtedly holds the record, among contemporary methods of working, for turning out gas containing the lowest percentage of nitrogen.

We have, however, to bemoan with Mr. Hayman that in this country we have a slow-witted set of legislators so far as technical questions are concerned; and that the larger makes from Oberspree and Mariendorf cannot be ours here until light penetrates an amount of mental obscurity. But there is no reason why all the other advantages of the intermittent or continuous systems should not be enjoyed, if they can be at reasonable cost. What these advantages are have been frequently enumerated; and an improved return, if the same market conditions prevail in this country as in Berlin, of 15d. per ton of coal for residuals compared with the horizontal or inclined retorts, and a saving in labour of 4·4d. per ton, would be among welcomed benefits.

The Other Papers Read.

THE separate consideration that has been given to the papers and report on carbonization in vertical retorts must not be interpreted by readers as representing that, in our judgment, the remaining papers are of minor importance. In aspiring for greater technical improvement, and in working for a broadening of the commercial base of the gas industry, there is the danger that what is going on around us in regard to labour may be disregarded until it is too late. Socialism is spreading its wings; the teachers of pernicious doctrines are encouraged by successes to greater activity; and these successes are due to the inactivity of others. Discerning ones foresee greater troubles in the future than in the past; and conciliation and arbitration boards will have their value put to the severest test. But it is beyond such provision for smoothing over trouble that Sir George Livesey has gone. He has endeavoured to get to the very root of labour difficulties; and has, in our belief, succeeded in extirpating it in the gas undertakings in which he is concerned, by means of the co-partnership system. This was the subject of the first paper read at the meeting. Sir George's argument was excellently put; and the principles of his scheme were beyond adverse criticism. There was no one in the discussion who pronounced himself hostile; the only questions were as to matters of detail and whether the lines of attaining the object were really the correct or best ones. We ask for the proof of practical experience that they are not; advancing in our support on the other side the thousands of workmen who are prepared to say that they are. It is somewhat to be regretted that the matter was not considered a little more fully from the side of the workers—from the points of view of social, moral, and intellectual improvement, all of which, it cannot be gainsaid, redounds to the common good.

The point was raised, When the living influence of the originator of co-partnership in gas undertakings is gone, what then? That influence, we have no fear, will continue to live and develop in the men; it cannot be torn from them. Those who possess property that they have been in better position to acquire cannot perhaps appreciate, without the object-lessons that co-partnership has given those who have

been engaged in it, the fact that the men being placed in the position to accumulate property under proper guidance and control, and then the possession of that property—the knowledge that they have something more than they had before, and that they have the opportunity of increasing it—has had a marked effect on character, in the bettering of homes, and in self-respect generally. We cannot believe that these influences, silent but active, operate in a single direction, and that none of the good effect penetrates the work rendered to the companies. The continuance of the growth of such influence is not dependable upon the life of any single man. And certain it is that these men will cling to the principles of co-partnership with greater ardour than they would do to the principles of militant trades unionism, which, as a rule, means all paying out and receiving nothing. The workers realize that under co-partnership they are not only improving their position, and obtaining a better security against old age than 5s. a week when their years are three score and ten, but they are creating capital by which labour is employed; and we know of nothing better than this that the worker can do within the limits of practicable means for improving position. The wages system is insufficient. It does not stop the sowing of discord and the rooting of the tenets of socialism; if it did, there would be no need of co-partnership or conciliation or arbitration boards. There must be something beyond it; a something which sows and roots in the worker the seeds and influences of mutuality of interest. Mutuality of interest is not impressed by a defined wage; but it is by co-partnership and its proceeds, which are something more than purely financial.

Merit and originality were contained in the paper by Mr. F. J. Bywater; and, for many reasons, we are expecting to hear more about it, and still more, we hope with confidence, about its author, who on this occasion made his *début* before the Institution. On all hands, the paper was recognized as a notable contribution, and one that treated of a subject that has been too much neglected in this country; and so much so that supremacy in production, it is alleged, is passing out of our hands. Coal is tested for its quality for purchase purposes, and to test compliance with contract. But refractory materials that enter so largely into the composition of retort-settings, are purchased more on reputation than quality; and Mr. Bywater shows that maintenance of reputation is subject to a consistency in the composition of fireclay material that does not exist in fact, and to treatment of the material not according to the time-honoured creed of the makers of fireclay goods, but according to the properties of the fireclay itself. Fireclay is not a homogeneous, regular compound; it is an indefinite mixture. This being so, a mere chemical analysis of the material is insufficient; something more is wanted—and something more than the crude and traditional practices that have been considered sufficient for the formation of judgment regarding tenacity and efficiency for purpose. That is in effect the author's message. The paper is for both makers and buyers. The latter cannot be expected to separate the constituents of fireclay, assay their proportions, and find their relative values. If they did so, it would be of little use to them. This part of the work is essentially a matter for the makers, with the object of obtaining the best production, and so restoring high reputation.

But Mr. Bywater does, and rightly, think that gas engineers should do more in subjecting samples of the manufactured materials to severe tests before purchasing. Of course, there is no test, as he points out, like a season's trial of the material under actual working conditions. But for preliminary and comparative tests, some kind of testing-furnace is useful. But the value of the information such furnaces give must be of a somewhat limited character. In small furnaces as described, it is impossible to reproduce the same conditions that exist in a retort-setting, where the material is subjected to time action and the disintegrating influences of the gases. The British fireclay material manufacturers will not find Mr. Bywater's criticism of their methods very palatable, nor will they appreciate the advertisement of the supremacy in refractoriness of German material, and the confirmatory speeches of such gas engineers as Mr. Charles Carpenter. The better quality of the German material is attributed to the application of more scientific methods. Whether this be true or not, the British maker has good raw material; and his protection is in his own hands. It does seem singular that this important subject of fireclay material should have been so long isolated from professional consideration; but now that it has been introduced in such an effective style, it is hoped it will be kept alive, until some fresh complexion can be given to the story that Mr. Bywater has had to regretfully tell on this occasion.

The contribution by Mr. J. Irminger is so full of points that it is almost difficult to say anything about it without running over the whole of the details. It is a description of the new Valby gas-works at Copenhagen, with much other useful information incorporated. One of the most controversial points in the contribution is the large percentage of air that Mr. Irminger uses for purification, by which he implies that all past theoretical considerations and practical observations in this regard are at fault. For years he has been using 4 to 5 per cent. of air; and occasionally, with good coals, 6 to 8 per cent. The common maximum allowance of 2½ to 3 per cent. without greatly affecting illuminating power, calorific power, and flame temperature, is therefore rejected by Mr. Irminger, who asserts that the loss of illuminating power is only about ¼ to ½ candle, and the loss of calorific power is negligible. There is something a little mysterious about all this, more especially as the author tells us that the quantity of nitrogen in the gas is practically the same—6·7 per cent.—whether the air is used or not. This is a case for inquiry. It is just possible that Mr. Irminger is on the right track of the explanation, when he says that he is of opinion that "a sort of combination by the light oils must be responsible for the small loss in illuminating power; the heating power being unaltered." Mr. Butterfield, though he does not advocate the use of such high percentages of air, has drawn attention to their use raising the temperature of the purifying material—thus preventing any loss of illuminating power by the deposition of hydrocarbons in the purifiers, and so masking, and to some extent compensating for, the deleterious action of the nitrogen of the air remaining in the purified gas. Anyway, in this matter, Mr. Irminger flies in the face of accepted faith.

The paper contributed by Mr. Edward Allen, of Liverpool, dealt with a subject which has not been before the Institution for eleven years, although it has been discussed more recently by both the District and Junior Associations. It is on the recovery of cyanides from coal gas. Mr. Allen gives a full and very completely illustrated account of the Davis-Neill prussiate process as carried on at the Linacre works of the Liverpool United Gas Company, the general principles of which are in the main similar to those of prussiate processes in use elsewhere, differing only from them in subsidiary points. It appears to occupy an intermediate position between the well-known processes of Rowland and Bueb on the one hand, and of Knublauch and Foulis on the other. In the former, the gas is washed with a solution or suspension of an iron salt before the removal of the ammonia, which latter supplies the necessary alkali, and yields largely or entirely insoluble prussiates, which have subsequently to be worked up into soluble salts. In the method adopted by Knublauch and Foulis, the gas is treated after the removal of ammonia, and soda is added to supply the required alkali; the product then being mainly soluble prussiate of soda. In the Davis-Neill process, the gas is treated before removing ammonia, but soda is also added to the iron salt; the product from the washer then containing partly soluble prussiate of soda and partly insoluble prussiates. The latter are converted into soluble prussiates in the subsequent distillation necessary to recover the ammonia present in the liquid; a little caustic soda being added to effect this change. The filtered solution is then evaporated and crystallized in the usual way. The financial results obtained at Liverpool have been satisfactory to Mr. Allen and his Company, but owing to the fact that prussiate manufacture is a highly competitive industry, no figures as to costs are given. Mr. Allen, however, rightly points out that the prussiate market is at present in a very depressed condition—prices ruling very low. He does not, therefore, recommend his colleagues to adopt prussiate recovery, unless market conditions improve—a piece of advice that they will probably be very wise in following.

After a service of twenty years with the Ventnor Gas and Water Company, previous to which he had for five years been employed in the Town Clerk's office, Mr. W. R. Maybee has been elected, out of 34 candidates, to the position of Assistant-Overseer of Ventnor.

The Council of the London Mathematical Society have awarded the De Morgan Medal for 1908 to Dr. J. W. L. Glaisher, F.R.S., for his researches in pure mathematics. Dr. Glaisher is a Director of the Harrow and Stanmore Gas Company and of the Barnet District Gas and Water Company.

THE INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE SIXTH ANNUAL GENERAL MEETING,

HELD AT THE

INSTITUTION OF MECHANICAL ENGINEERS, STOREY'S GATE,
AND THE CONGRESS HALL, FRANCO-BRITISH EXHIBITION, SHEPHERD'S BUSH, LONDON,
JUNE 16, 17, and 18, 1908.

MR. W. DOIG GIBB, M.INST.C.E., OF NEWCASTLE-ON-TYNE, IN THE CHAIR.

REVIEW OF PROCEEDINGS.

(For full Report see page 782.)

THE years seem to roll by with increased rapidity. As one stood in the vestibule of the Institution of Mechanical Engineers last Tuesday morning watching the familiar scene associated with the annual reunion of the members of the great British gas profession, it appeared almost impossible that two years had winged their way since all that was passing then had last been enacted in these particular surroundings. But so it was. It was all, however, the same—the same faces, and the same pleasure in the salutations of friendship. The remembrance of these occasions always causes gratification to well up in its happiest manner. But we will not linger on a scene, and on the emotions stirred up by the occasion, with which all are so well acquainted; for while meditating on what was passing around, the hall had become well filled. Precisely to prearranged time, 10.30, the President (Mr. W. Doig Gibb, M.Inst.C.E.) entered the doors at the back of the daïs, and was greeted with heartiness. With him were Mr. Thomas Glover and Mr. James W. Helps (the Vice-Presidents), the Hon. Secretary (Mr. S. Y. Shoubridge), the members of the Council, and the energetic Secretary (Mr. Walter T. Dunn). It was interesting to glance at the *personnel* of the directing body of the Institution collected on the platform. It led one to reflect on the thoroughness of representation on the Council that the affiliation of the District Associations has given to the British gas profession. England in all parts and Scotland and Ireland had their deputies there; and that is how things should be in the counsels of such a body as this representing the technical officials of an industry that has its feet planted in every town.

There was a business-like air about these opening proceedings. The preliminaries were disposed of in a manner that would have done credit to a City commercial meeting. Even the Council's annual report was adopted without any word of comment. Not so much as a word of thanks fell to those who had looked into the question of insurance under the latest of the Workmen's Compensation Acts, nor was there remark upon the work of the Sub-Committee on Carbonization, nor upon the introductory report of the Committee and their coadjutors of the Leeds University who are engaged in investigating the most economical and best means of utilizing gas for heating purposes. Perhaps this was due to the fact that their work is incomplete. The whole report, however, was passed as though presentation marked finality. The introduction of personal matters always arouses interest; and the reception of the Council's report without comment dropped the meeting immediately into one of those little episodes of the annual gathering that are always looked forward to with interest. This was the award of the London gold medal, and the silver and bronze medals of the Institution for papers read at last year's meeting. It is a difficult—and sometimes invidious—task that the Council have in adjudicating upon the papers for the bestowal of these medals; and it is always to them a satisfaction when the members, with such unanimity as on this occasion, approve of their choice. Mr. J. H. Brearley had the honour of receiving the London gold medal for his paper—which presented the essence of much labour—on "The Testing and Hygienic Efficiency of Gas-Fires;" Mr. F. W. Goodenough, the silver medal for his instructive paper on "The Sale of Gas;" and Mr. R. M. Searle, of Rochester (New York), the bronze medal for his luminous contribution upon "High-Pressure Distribution in the United States." The presentations were gracefully made by the President; and acknowledgment was made by the recipients—excepting Mr. Searle. He could not, of course, journey to London solely for such a purpose; and as a link—and a worthy link—between gas-works engineering in this country and America, Mr. A. G. Glasgow was called up to take charge of the medal, and to safely transfer it to Mr. Searle. Characteristic was Mr. Glasgow's acknowledgment for his friend. He recognized with all humility that he could not himself earn the distinction of a medal from the Institution, but profoundly thankful was he for the compliment paid him in asking him to receive one for somebody else.

The Presidential Address.

The President was again on his feet; and this time to deliver his address—an address which peculiarly in the Institution simply inaugurates not the President's year of office, but only the proceedings at the annual meeting. It is one of those addresses that in the coldness of print is robbed of much of that individuality that its composer attaches to it in its deliverance. The modulation of expression gave marked emphasis to point and life to composition. The address was published in last week's issue, and comments on it appear in our editorial columns to-day. The need for summary is therefore removed. But briefly it may be said that the President's reference to the affiliation of the North British Association, and the hope that "we may now all be still closer knit in friendship's ties each passing year," conformed with the mood of the meeting; and the applause was great. His remarks on the fields for gas and electricity were well-chosen and endorsed. The more technical questions of carbonization and of large capacity railway waggons—the gains of the latter, and the requirements in the construction of railway tracks and sidings in consequence of the changes these larger waggons produce—were listened to most intently. When the President came to deal with the subject of the recovery of bye-products, and, in passing, spoke of the great assistance rendered in chemical questions by Mr. R. Forbes Carpenter, the Chief Inspector under the Alkali Works Regulation Acts, and by the District Inspectors, the deserved acknowledgment was sealed with spontaneous applause that was the best attestation of the members' appreciation of a liberal interpretation of duty, and freedom from that tight-laced officialism which, with narrow-mindedness, construes inspection to mean nothing but watchfulness with the view to entrap.

That the President proved his case as to the utility of motor vehicles for gas undertakings was apparent by the agreement expressed when he came to the finishing words of this section: "It is certain that where full loads have to be carried considerable distances without breaking bulk, a great saving can be effected by displacing horse traction in favour of motor vehicles." A strong case was constructed by the President in favour of a size of coal-testing plant more nearly representing working conditions than the laboratory plant, in these times when the difficulties have become general of getting 2·24 lb. samples that fairly show the character of the bulk. There was no doubt that he had the sympathy of a majority of his audience with him in this matter; but when he gave voice to the belief that general

and intelligent experimental use of such larger sized testing plants might result, "for instance, in retaining the valuable naphthalene as a permanent gas, and prevent further attempts to solve the question of getting rid of it as a nuisance," there was one who was present, and who is well qualified from experience to pronounce an opinion, who (though it was only audible to his neighbours) questioned the latter part of the statement. Through commonsense reasoning and facts within his knowledge, the President declared himself as irreconcileable to the Coal Mines' (Eight Hours) Bill. Other matters were touched upon in the address, including high-pressure distribution, the everlasting question of the training of young engineers, and the benevolent fund. The President's remarks on the fund can be appropriately referred to in glancing at the proceedings at the meeting of the subscribers on the Wednesday morning. There was cordial appreciation of the address on the invitation of Mr. Charles Hunt, seconded by Mr. W. A. Valon.

Co-Partnership—The Only Way.

The unflagging zeal with which Sir George Livesey has over the past nineteen years, advocated the only way that he has discovered for uniting the interests of capital and labour is proof of a profound belief, and is—whether or not there is agreement—a matter for the admiration of all. Never has a good cause had a more ardent champion; and it was the recognition of this, and because Sir George has proved in the cause such a sincere and stubborn fighter, that moved the members to give him such a spontaneously enthusiastic welcome as the President named him for the first paper. He has appealed oftentimes, at meetings of gas men, for sympathy and help in forwarding this system for knitting capital and labour together in the bonds of a common interest. Three times during the development of the system did he bring it before the old Institution of Gas Engineers; and, in its complete form, he introduced it to the Southern Association last November. But this is the first time that the system, as a whole, has been brought before the organization representing the undivided British gas profession; and he asked the members, if any of his statements appeared to be a little dogmatic, to merely take them as the decided views formed from his nineteen years' experience.

The paper was not burdened by any description of what co-partnership means, nor of the lines on which co-partnership in the gas industry is conducted; but it was a simple and condensed argument, built up on an unsurpassed experience, for bettering, through an understood system, the relationships of capital and labour and improving the position of the men. "Look around; read the newspapers." The author puts what we see and what we have read in a nutshell. Disturbance in industry; gulfs between capital and labour; and the best of proposals other than co-partnership proving themselves only palliatives—being merely based on the assumption of divided and opposing interests. Listening on, we hear how, without interests are united by strong bonds, present peace is on an insecure foundation. Unrest and fear, the embers of which fanned into flame by the Gas Workers' Union, gave impetus years ago to the application in gas-works of labour-saving machinery; and a continued application of such machinery is partial evidence of the fact that the unrest and fear have not been completely extirpated, and that uncertainty still exists. Sir George is for the man, rather than the machine if there is no economical advantage attaching to the machine; for the man has intellect, and it is one of the objects of co-partnership to induce the exercise of intellect to the utmost advantage of the co-partners. Exercise of intellect improves the man, and if directed to right ends, ennobles character. And, through co-partnership, from this good effect material benefit ensues to all. The torpidity in adoption of the movement in the gas industry, Sir George chiefly and generously ascribes to conservatism; but there is fear that the outgoing for co-partnership is looked upon as unproductive. Does co-partnership pay? Sir George in his paper says emphatically that it does; and he says this on an eighteen years' experience. It is, in fact, "the only sure and certain settlement of the Capital and Labour question." The paper deals with the point more fully, and the Southern Association paper still more extensively. In the present one, too, Sir George gives ten reasons for adopting co-partnership, which by-the-bye is something more than simple profit-sharing.

Throughout the reading of the paper, it was evident that Sir George's whole heart was in his advocacy; and as he quoted the divine words, in the concluding sentences of the paper, "Therefore, all things whatsoever ye would that men should do to you, do ye even so to them, for this is the law and the prophets," and then ventured "humbly and reverently to submit that their application to the business relations of employers and employed is the system known as Co-Partnership," there was warmth and sympathy in the applause.

The discussion was a good one. To the fundamental principles of co-partnership, there was really no opposition. The greater number of the speakers were in favour; but it was noticeable that only those who have adopted the system, or its cognate profit-sharing, spoke out in favour. Many no doubt there were present who, in their hearts, are in complete accord, but were silent—this being a matter primarily for their administrations. Other speakers were mainly inquirers, or, like Mr. C. Stafford Ellery, questioned the right of co-partnership to assume that it was the only way of attaining the ends aimed at. Named in the order in which they joined in the discussion, the speakers were Mr. Hubert Pooley, Mr. S. Y. Shoubridge, Mr. C. S. Ellery, Mr. H. W. Woodall, Mr. T. Berridge, Mr. Charles Meiklejohn, Mr. T. Hardie, Mr. Adam Cooke, Mr. J. Wilkinson, Mr. Charles Carpenter, Mr. Herbert Lees, and Mr. E. A. Harman.

The full scheme of co-partnership cannot, of course, be applied to local authority undertakings. It can partially; but how, certain speakers were curious to know, little heeding that Mr. Pooley, in opening the discussion, had pointed the way, and had testified to resulting benefits. The scheme as practised at Stafford—and which was inaugurated by Mr. J. Ferguson Bell, but was subsequently revised—will be found set forth in the report of Mr. Pooley's remarks. But, of course, in local authority undertakings, a perpetual interest can only be maintained by the knowledge of additional pecuniary reward; in company concerns, where the men's bonus can be invested as capital, there is established a permanent stable interest. Illustrating what that interest is was stated for the South Suburban Gas Company by Mr. Shoubridge; and what has been done there is merely typical of what has been done elsewhere. The price of gas has been reduced, dividends have been increased, salaries are on a higher scale, and works have been improved out of revenue, during the time that the men have been building up a substantial sum in the capital. There were those in the discussion who declare they have no trouble with labour, and their men evince goodwill. Quite true. The reply of Sir George is that that was the state of things in the South Metropolitan Company before the great strike. Goodwill alone is not proof against the wiles of the agitator.

There were those, too, in the discussion who seem to think that the wages of the men are affected by the fluctuations in the degree of prosperity; but it was explained to them that the wages—and they are good wages—are not in any way touched. It is only the reward additional to wages that is affected; and this is where the workers enjoy the privilege as partners of increased profits according to the prosperity they help to create, and suffer a reduction of profit according to the depression occasioned by uncontrollable adverse circumstances. In this manner, and within the limits only of the bonus, they share the benefits and reverses of fortune equally with the other shareholders and the consumers. There was some objection taken to written agreements with the men; but the answer to that is that the men like the agreements, because they really give them security in tenure of position, subject to good behaviour. Again the point was raised how are those works to offer any advantage to the men where the price of gas is already low, where the consumption of gas is now but slowly increasing, and where things are already cut fine—it being submitted that any improvement that can be made in such places by more productive labour might throw men out of employment. The reply of Sir George is, then give the men 5 per cent. on their wages on the low price, the same as has been done at Rugby. There will be recompense in the security and interest in work that this develops, in the increased interest and contentment that it encourages, and in the thrifty habits that it engenders among the men. It makes them owners of something they did not possess before; and it forges a link between them and the business in which they are engaged that had no co-equal before. The words of Mr. Meiklejohn were apt: "I did not recommend the scheme of co-partnership, because Sir George was right, but because the scheme was righteous." Men may scoff; but the truth of the words remain.

Vertical Retort Results from Germany.

It was good of Mr. Ernest Körting, as he could not himself comply with the request of the Council that he should contribute a paper on the most recent experience with the Dessau vertical retort system in Germany, to obtain such an able deputy as Mr. A. F. P. Hayman, of Berlin, who, it will be remembered, was at the meeting in Dublin last year. Like Mr. Körting a couple of years ago in the hall of the Mechanicals, this gentleman was received with the utmost cordiality as he rose to read his paper immediately after the discussion on Co-partnership. We have recently shown the immense progress that the Dessau vertical retort system has made in Germany. In fourteen German towns alone, there are already installations representing no less than 888 retorts. Indeed, Mr. Hayman tells us, the system holds the field against all comers. There are several other installations of considerable size in progress.

The importance of the paper, however, rested more in the results of the operation of the system than in any other aspect. The results from the Oberspree and Mariendorf verticals have been previously published in the "JOURNAL" pages. Average figures from Oberspree during April and May, after fifteen months' continuous working, bring their confirmation. The gas produced per ton of coal in April was 13,185 cubic feet, and in May 13,205 cubic feet. This was using steam; the calorific power being respectively 555 and 554 B.Th.U., and the illuminating power 11·40 and 11·35 candles. Tests made at the Karlsrühe testing-station of Mariendorf gas (Silesian coal) gave 13,707 cubic feet per ton with steam, and 11,375 cubic feet without steam; the respective heating powers being 551 and 601 B.Th.U., and the average illuminating power 11·89 and 15·87 candles. The low percentage of nitrogen is striking—1·40 with steam, and 1·10 without. The fuel used was 14 and 14·23 per cent. respectively. Tests at Cologne, without steam, give 11,931 cubic feet of gas per ton, and with steam 13,068 and 13,616 cubic feet. The coal used is not stated. The heating values are much the same as in the case of the Mariendorf retorts. It is noticed that the Cologne gas gives the percentage of carbon dioxide as 1·1 without steam, and 2·3 and 2·0 with steam; and of nitrogen 4·0 without steam and with steam 4·0 and 3·4. At Dessau (4-metre retorts, not 5-metre as at Berlin), a test has been made to find the quantity of 14 Hefner unit gas that could be produced from Boldon coal. The result was, with steaming 14,650 cubic feet of gas of 589 B.Th.U., and 13·6 Hefner units (using the Carpenter test-burner). Improved results are also obtained in residuals by this system of carbonizing; figures quoted in the paper showing between inclines and verticals an additional value of 1s. 3d. per ton of coal carbonized. The gain is sufficient to pay for the interest and amortization on the capital outlay, and to leave a handsome profit.

Among miscellaneous, but still important, matters commented upon by Mr. Hayman were the regularity and smoothness of working, the absence of difficulty in maintaining proper heats, the perfection of the discharge of coal, the freedom from stopped ascensions, scurfing at only six or seven weeks' intervals, labour reduced to a minimum (only four men being required in twenty-four hours for a production of 1¼ million cubic feet of gas), and no extraneous labour-saving machinery required. A table giving comparative costs of labour per ton between inclines (9·4d.) and verticals (5d.), show a saving by the latter of 4·4d. per ton. A matter of importance to this country is the amount of bisulphide of carbon in gas. At Oberspree, a test shows only 12 grains with oxide purification; and at Cologne, 17·35 grains. The amount of cyanogen is less by nearly 25 per cent.; and scarcely any naphthalene is formed. Indications are, too, that wear and tear will be considerably lowered, compared with predecessors. These, in brief, are among the points of Mr. Hayman's paper; but, in the end, he has one little kick at the old-fashioned notions of our legislators as to illuminating power, referring with pride to the success of low-grade illuminating gas in Berlin, with a calorific value approximately uniform at from 550 to 560 B.Th.U. The paper is replete with interest.

Continuous Carbonizing.

The Council are to be congratulated on having prevailed upon Mr. Harold W. Woodall to at length come forward with an account of his work in conjunction with Mr. A. M. Duckham, in trying to solve the problem of continuous carbonization in vertical retorts—the solution of which has been found to be more one of mechanics than of retorting. The paper Mr. Woodall read, the Council had decided should be discussed in conjunction with that of Mr. Hayman. It was an interesting contribution; a large part of it being devoted to a history of the work that the joint inventors have been engaged upon. The beginning was five years ago; and what a history it has been for the workers! They set themselves a task, complex and extensive; and in reaching a successful end, they have left behind them a long trail of difficulties and of deferred hope. As the work proceeded, principles remained, but defects of method were everlastingly revealing themselves. The task has, however, at last been achieved. And it is only this achievement that has induced Mr. Woodall to now face the gas industry. Nothing would draw him before, until success had rewarded labour to the satisfaction of himself and his colleague. It is an interesting history, but too long to sketch outside the paper, the text of which is given elsewhere. Of late, the greatest perplexity has centred about the bottom conveyors for the removal of the coke; but the discarding of these conveyors, and the application of a simple curved plate with special roller extractor, and a rotary self-sealing discharging drum have overcome all difficulty.

Passing from the historical narrative, the results are given as derived from the settings at the various stages of development. The makes of gas will be seen to be good. Among the later results are found, with the Bourne Valley retorts, an average production of 13,190 cubic feet of 14·1-candle power gas (Carpenter burner) per ton of coal; and with the Nine Elms retorts, 12,423 cubic feet of 15·82-candle power gas, of 530·7 B.Th.U. net. An analysis of this gas shows 2·22 per cent. of carbon dioxide and 6·32 per cent. of nitrogen. A test of the single retort with the new coke-extractor fitted at Poole, over ten days (the figures are included merely as trial ones, and for what as such they are worth) records an average make of 14,165 cubic feet of 14·26-candle power gas, and 551 B.Th.U.; the percentage of carbon dioxide being 1·73. The makes of gas were considerably higher in the original settings; but this was gas of very low illuminating power, through the use of an unlimited amount of steam. And Mr. Woodall tells us he is now confident that, where a considerable amount of water gas is required, the best method of obtaining it is by means of independent special plant and apparatus, and not by means of the coal gas retorts.

Among miscellaneous points in the paper, it was heard that Mr. Woodall is of opinion that, with continuous carbonization, the eventual cost of retort-house wages will be found somewhere in the neighbourhood of 6d. per ton—a figure originally estimated by Mr. W. R. Herring, and very close to that quoted by Mr. Hayman. An important feature of continuous carbonization is that it enables any class of coal to be used, no matter how much it may swell on heating. As to the life of the retorts, there is every reason to believe it will be a long one. The hydraulic main disappears; and the ascension and arch and dip pipes are replaced by one short piece of pipe, about 2 feet long. Smoke, dust, and dirt are absent; and the conditions of labour are consequently much improved. Nothing but a lightly constructed protection is required over the settings. Not only is the gas increased in quantity, but the tar and ammonia show improved yields. The gas is free from naphthalene; and the coke is relatively better from any class of coal. In his concluding sentences, Mr. Woodall expressed the hope that, when the history of the work done is perused, it will perhaps be considered that the ground covered has been sufficient to justify the time occupied. This cannot honestly be questioned.

A Report to the Carbonization Committee.

After the reading of the papers, there was a postponement of the discussion to the following day; and this was taken after the lecture. It will, however, be more convenient to complete at once the story told at the meeting of carbonization in vertical retorts. There was a surprise in store for the members. As was hoped in the report of the Council, Mr. A. E. Broadberry and Dr. Harold G. Colman who had visited Dessau and Berlin to investigate the vertical retort systems had pressed forward with their report, and were able to submit it to the members on Wednesday morning in printed form. It is a remarkably clear report; and though, to some, it may appear to be a little overdone in detail, it must be remembered that this is really on account of what transpired on the mission entrusted to the reporters by the Carbonization Committee. And the detail is necessary so as to show why the delegates were unable to personally make

tests at Berlin, and to indicate conditions that may have had influence on results in connection with their tests at Dessau. There is no doubt about the facilities that German colleagues are ever-ready to render to all associated with the gas industry who desire to test for themselves the results from vertical retort working. Mr. Broadberry and Dr. Colman bear witness to the advantages that have been claimed for the Dessau system. But singling out one set of the figures in their report for notice in this review, it is seen that, in the tests with the 4-metre retort, the yield of gas without steam was 11,259 cubic feet of 16·45-candle power (Carpenter burner) and of 543 B.Th.U. net; and with steam 11,680 feet of 15·37-candle power and 535 B.Th.U. net.

There is a point upon which Dr. Colman laid great stress in presenting the report; and it is that, by direct determination, very low percentages of nitrogen were found in the vertical retort gas—the amount being very much less than is usual in the gas obtained from horizontal and inclined retorts where makes of 11,000 cubic feet and more per ton are obtained. The figures indicate that the gas yield from the vertical retorts is not being swollen by producer or waste gas accidentally drawn in from the setting. The report says: "The amount of nitrogen actually found, 2·1 to 3·7 per cent. is probably mostly derived from the usual small proportion of air inevitably drawn in on the vacuum side of the exhauster, as, though no air was purposely added to the gas during the tests for revivification purposes, the gas samples all contained from 0·2 to 0·4 per cent. of oxygen." The amount of sulphur in the purified gas was found to be 21·7 grains per 100 cubic feet. In introducing the report, Dr. Colman gave figures—comparing with tests made at Dessau by Mr. Broadberry and himself—supplied by Dr. Bunte, jun., at Mariendorf, and by Dr. Bunte, sen., at Zurich. The Dessau figures for nitrogen were 2·9 per cent. in the gas without steaming, and 2·6 per cent. in the gas with gentle steaming; and Mariendorf, 1·1 per cent. in the gas without steaming, and 1·3 per cent. with copious steaming. In this table (as will be seen by reference to it), the coke used as fuel is a notable point. Reverting to the report, it is full of interesting matter; but the advantages are summed up thus: Low labour charges; low cost of repairs both as regards the retorts themselves, and their very simple mechanical equipment; the high quality and superior density of the coke, and the almost entire absence of breeze; the satisfactory average yield, the purity, and the lighting and heating value of the gas; the increased yield of ammonia; the thinness of the tar and the avoidance of retort-house troubles resulting therefrom. The chief drawback is the heavy pressure of the gas at the bottom of the retorts during the early stage of the charge. In overcoming this trouble, Herr Körting has met with an encouraging amount of success by the separation of the small coal and the large nuts, and feeding them into the retorts in a distinctly divided stream.

Points in the Discussion.

It was a pity that the discussion on the two papers and the report had to be somewhat abridged owing to pressure of time; nevertheless, in the greater part of an hour devoted to the discussion, there was a copious flow of views—more views than inquiries. The first speakers were (introducing their joint report) Dr. Colman and Mr. Broadberry; and then followed Mr. Edward Allen, Mr. J. P. Leather, Mr. J. H. Brown, Mr. T. Glover, Mr. R. G. Shadbolt, Mr. S. Glover, with brief replies by Mr. Hayman and Mr. Woodall. Looking at the discussion as a whole, the speakers were not, with one or two exceptions, very critical; letting undoubtedly, friendly feeling modify uttered opinions. The strongest points were, of course, made by those who have had opportunities of directly investigating the working of the verticals. Upon the question as to volume of make, there was really no comparison made between the results emanating from the Dessau and Woodall-Duckham working. Some people do not consider the makes as anything extraordinary; but Dr. Colman made a strong submission under this head. The gas produced by the vertical system is gas with low percentages of nitrogen in it; and the figures have to be compared with makes from horizontal retorts containing perhaps 9 per cent. of nitrogen. With the Dessau system, the drawing in of furnace gas is almost an impossibility, owing to the pressures existing in the retorts throughout the period of carbonization. The gas too is not overheated; and there is a noticeable point in the absence of free carbon. If the figures produced at the meeting are carefully compared, it will be seen that there is, with the German system, little difference between results in different towns—only such as may be yielded by using different coals, and varying quantities of steam. Upon this steam question, since Dr. Colman first introduced the matter in the "JOURNAL" some time ago, there appears to be a growing opinion that the making of steam by the retorts is not so preferable, from the result point of view, as making it or water gas, if required, independently. But there is the consideration advanced in the "JOURNAL," and by Mr. Hayman at the meeting, as to the separate plant necessitating extra capital outlay and labour charges. That is not a point that settles the question.

This point was also raised in the discussion—that, in the continuous system, the coke, through disturbance during the period of carbonization, must be lighter and looser. The reply of Mr. Woodall is that the coke, from the continuously operated retorts, is closer and harder than the coke from the old systems of working; and there is a good demand for it at an improved price. Some samples of coke on view from the Dessau retorts were admirable both in texture and hardness. While on the question of coke, the fuel account with the Dessau system appeared to speakers to be rather high; but it was pointed out that the steaming which produces the higher make is largely responsible for this. Then saving in labour seems to Mr. Leather to be due to, in the Dessau system, the knocking out of one of the shifts, and through keeping the retorts full; so that he does not ascribe this saving entirely to the fact that the retorts are set vertically In Mr. Leather's and Mr. Glover's opinion, the continuous system is the ideal one; and Mr. J. H. Brown does not appear to be over-enamoured of some trials that have been made at Dessau with his local coals. As Mr. Woodall tells us, with the continuous system the retorts have not to be opened; and there is no dumping of cold heavy charges into them. There is a constant cycle of conditions. Mr. S. Glover goes so far as to say that the Dessau retort is an unscientific instrument. On the other hand, there is plenty of evidence available from this meeting as to advantageous results of the Dessau system in respect of gas, residuals, and so forth such as we want in these days; and Mr. Hayman suggests that wear and tear will be considerable with the continuous system—a condition of things that is not borne out by Messrs. Woodall and Duckham's experience. There is another consideration—the difference per foot length of retort in the gas production between the Dessau and the continuous system; the advantage being decidedly on the side of continuous working. This being so, as Mr. Broadberry says, the capital costs should not be considered at per retort or setting, but should be calculated in relation to capacity per 24 hours. Herr Körting gave information on the point of capital in comparison with horizontal and inclined systems in his article in the "JOURNAL" for Jan. 14 last. It is interesting to hear that Mr. S. Glover's plant on the Young and Glover system, now being erected at St. Helens, is going to be a complete working unit; so that we shall in due season get some authoritative records from it. The reception that was given to Mr. Hayman and Mr. Woodall when they rose to reply to the discussion was (we may say without extravagance) rapturous and a fit tribute, through them, to the workers who have laboured so well to conquer and achieve in this fresh field of carbonization method.

District Associations and the Benevolent Fund.

For convenience, the discussion on the vertical retort papers has been dealt with in this review prior to noticing the first two matters to engage attention at the sitting on Wednesday morning. Before the ordinary business was proceeded with, the meeting of the subscribers to the Benevolent Fund was held. Again, the report of the Committee had to lament the fact that the receipts (£235 3s. 9d.) did not equal the expenditure (£248 17s. 6d.). The repeated efforts of the Committee to beat up interest in this deserving fund does not make substantial headway in gain. As Hon. Secretary of the Midland Association, Mr. Charles Meiklejohn has done a great deal in awakening interest in the fund among the members in that area; and the report of the Committee recognized it. Through his energy, the fund is the better by some £80, which includes the special donation of £26 5s. by the Midland Association, and £30 by Mr. Hack—representing back subscriptions from the time when there was disruption; the remainder being from private individuals.

Cannot something more be done for the fund through bringing the District Associations into closer connection with its working? The President suggested, in his address,

the formation of what he termed Local Committees to press the claims of the fund, and to assist the Central Committee in connection with deserving cases. He referred again to the subject in bringing the report before the subscribers at their meeting. Mr. J. Ferguson Bell, who moved its adoption, was favourable; and Mr. Tim Duxbury went a step further by suggesting that affiliation having become an accomplished fact, there should be on the Benevolent Fund Committee a representative of each District Association. But why not do the whole work of the fund through Local Committees formed by the District Associations; of course, retaining the Central Committee for general administration? The subscriptions might be collected by the Local Committees; and the Central Committee could do the work of dispensation through the same channels. The Manchester Institution are, Mr. Duxbury states, going to do their share in rendering support. The only other business at this meeting was the unanimous election of Mr. Corbet Woodall as a Trustee of the fund, in place of the late Mr. W. J. Warner. Mr. Woodall, in his reply to the invitation to take this office, welcomed any opportunity of being of service to the Institution, and especially to the Benevolent Fund.

Combustion and Thermal Decomposition of Hydrocarbons.

The long table on the President's platform was covered with chemical appliances of many kinds, the walls bore several figured cartoons, and the lantern sheet was down—all betokening a vast amount of interest in the lecture that Professor W. A. Bone, D.Sc., F.R.S., was to deliver to the members on the subject mentioned at the top of this paragraph. It proved to be a lecture of considerable length—occupying a quarter of an hour beyond the ordinary time allocated to such deliverances at the meetings of the Institution. But it was worth the time. True it overthrew the theories of some past workers; even certain of those formed by Professor Vivian B. Lewes in relation to certain phases of the subject. We heard more about the action of high temperatures on the hydrocarbons of coal gas than has been heard before; and therefore the lecture marked an advance in the work scientifically done in this particular direction. If there had been no more gathered from the lecture than the important action of heated surface on methane, then the time spent in listening to the lecture would have been well occupied. We are, of course, as Mr. T. Glover said in the discussion, interested at the present time more in the decomposition of hydrocarbons in retorts than in flames; and the vertical retort has been demonstrating to us that we have been losing in volume of gas by the decomposition of hydrocarbons, and the formation of free carbon. Theory and practice have been pursuing parallel courses.

We may indicate here the trend of the lecture. Professor Bone, after a short survey of the theories of the thermal decomposition of hydrocarbons previously advanced by Marchand, Berthelot, and Lewes, gave an account of the researches recently carried out by himself and Mr. Coward on changes taking place by the action of heat on the hydrocarbons methane, ethane, ethylene, and acetylene at temperatures varying from 650° to 1150° C.—illustrating these in a most successful manner by a number of interesting experiments. The decomposition of methane was found to be very slow at temperatures below 800°, but increases with increasing temperature; and, in the main, the change taking place appears to be a direct decomposition of the gas into its elements, carbon and hydrogen. The decomposition at these temperatures, moreover, does not appear to occur in the gas itself, but only where the latter is in contact with heated solid surfaces, on which the carbon is deposited as a hard, dense, lustrous mass, exactly resembling retort carbon; whereas the carbon obtained in a similar way from other hydrocarbons has a totally distinct physical character, being loose and flaky. Professor Bone believes that retort carbon, and also the bright, lustrous layer on the surface of oven-coke, are both formed by the thermal decomposition of methane in this manner.

The decomposition of ethane and ethylene proceeds in quite a different manner, as this takes place not merely where the gas is in contact with a heated solid surface, but throughout the gas; the carbon formed being, as already stated, of a loose flaky nature. Experiments made at 800° C. gave the most information; for at this temperature the methane formed does not undergo any further material change. Acetylene is found in the initial stages in small quantity, but soon disappears; and the chief final gaseous products are methane and hydrogen. An interesting point in connection with ethane is that this hydrocarbon at 800° yields some 4 per cent. of its weight of almost pure naphthalene. The results obtained in these experiments do not confirm the views of Lewes as to the all-important part played by acetylene in these thermal changes. Acetylene itself at relatively low temperatures of about 650° behaves again in a different manner, as it then largely undergoes polymerization into liquid or solid aromatic hydrocarbons such as benzene C_6H_6 and styrolene C_8H_8, as previously shown by Berthelot. At higher temperatures, however, it is decomposed in a generally similar manner to ethane and ethylene; the final gaseous products being again chiefly methane and hydrogen.

The formation of such large quantities of methane in the decomposition of the hydrocarbons ethane, ethylene, and acetylene cannot be accounted for by any of the theories previously advanced; and Professor Bone advocates a new theory in order to explain this fact. According to his view, the methane is not the primary product of the decomposition, but, in the first instance, in addition to hydrogen substances such as $-CH_3$, $=CH_2$, and $\equiv CH$, are formed. These, however, are incapable of anything more than a transitory existence, and either combine with each other to re-form hydrocarbons such as ethane, ethylene, or acetylene, or if hydrogen is present (as it always is in such cases), combine with this gas, forming methane. The lecturer then showed experiments confirming this view, in which it was proved that the presence of an excess of hydrogen when such decompositions are going on, greatly increases the amount of methane produced. Before concluding, Professor Bone gave a short *resumé* of his work illustrated by experiments, on the mechanism of the combustion of hydrocarbons, which he had previously given in his lecture at the Royal Institution last Spring.

Sir George Livesey, at the close of the lecture, made another appeal for the collection of the remainder necessary to make up £500 a year for the support of the work at Leeds University which Dr. Bone has under his supervision in connection with gaseous and solid fuel. Sir George has promises amounting to £388; he now wants the balance of about £120 a year. There is a great deal of truth in what he says that practical gas men have not the time for these researches into the higher problems of gas manufacture and utilization, which must be investigated and solved to enable the greatest advances to be made. At the present time, as has been said more than once, the gas that Parliament has in latter times given permission to gas undertakings to supply cannot be produced from coal alone, under existing carbonizing systems, without steaming or admixture with water gas. For such reasons, outside scientific aid is essential; and we cannot afford to ignore that aid in research to point the best way.

Interest from Copenhagen.

Mr. J. Irminger, of Copenhagen, was at the meeting of the Institution in Dublin last year. This year he has been among us again, taking a more prominent part. We of this country are so closely allied with Denmark through the Royal House, that there is a feeling that the affairs of that country are our affairs, and that our affairs must be those of that country. Therefore, it was with especial interest and with manifest pleasure that the members heard from Mr. Irminger, before terminating their sitting on Wednesday, an account of the new gas-works that he has constructed at Valby—a district outside Copenhagen—and which works have been necessitated through the magnificent growth of gas consumption in the city. In a prelude to the subject proper, we gather information as to the expansion, which was represented, in the twelve months to March, 1907, by an output of 2021 million cubic feet; and, in the succeeding year, there was an addition equal to 6 per cent. This, notwithstanding the price of gas. Differential prices obtain here; illuminating gas being sold at 4s. 11d. per 1000 cubic feet, and gas for cooking and motor purposes at 3s. 3½d.; and this is gas of 13-candle power only, but with a heating value of 575 B.Th.U. Having regard to the price for cooking, the meter connections are remarkable. In 1907, there were 30,632 meters fixed for lighting, no less than 89,876 for cooking, and 25,521 were slot meters; and to the total there has since been an addition of nearly 6000.

But we must not stay over these interesting statistics. They go to show the necessity for the new Valby works, and the laying out of an 87-acre site for plant to ultimately

produce 20 million cubic feet, including a carburetted water-gas plant of 6 millions. At present, however, only one of four retort-houses has been built. Mr. Irminger's paper mirrors his selections of plant and processes for these new works. A railway and viaduct connect harbour with coal-stores. Opposite each store are five coal-hoppers, under which passes an automatic railway by which the coal is taken into store in 1-ton waggons, working on Hunt's system. Mr. Irminger is an ardent believer in reinforced concrete; and throughout the works he has extensively used it. The retort-house is longitudinally flanked by coal-stores, each capable of containing 15,000 tons of coal. The retort-house contains 32 settings of eight throughs; and, when it is said that West's compressed-air stoking machinery, and the same makers' coal and coke handling plant, are the chosen methods for Valby, a lengthy description is avoided. The conveyor, however, brings us to remark upon the large extent to which Mr. Irminger has applied electricity for power purposes in these works—beginning with the conveyors. There are, in fact, no less than 30 electric motors dotted about the place; and in the engine-house is found the generating plant, with two large three-cylinder gas-engines provided for the primary work. The air-compressors and the exhausters are in this house; and therefore it is an interesting building.

Interspersed in the descriptive notes are hints as to working methods. The coke-handling plant is described. The combined water and air condensers, the boiler-house, and the provision for dealing with tar and ammonia come in for attention. The underground reservoir for tar and ammoniacal liquor is fitted with separating apparatus; and close by are the tar centrifugals which remove all the water from the tar with the exception of about 1 per cent. Nearly all the tar is treated in this manner; and it commands a higher price and easier sale than the crude tar. Experiments incorporated in the paper at this point show the necessity for having a good covered ammoniacal liquor tank. The prevention of loss of ammonia is demonstrated by experiment to be very considerable by the simple provision of a cover. In describing his purifiers, the author in effect admits that he is in the habit of ignoring theoretical considerations and common practice in respect of the amount of air he passes in with the gas for the purpose of assisting in the purification. He goes up to between 4 and 5 per cent.; and, under the conditions of his working, the loss of illuminating power is stated by him to be only from $\frac{1}{4}$ to $\frac{1}{2}$ candle, and the loss in calorific power negligible. The building of the new gas-holder tank is explained; and how the author dealt with rather a high water pressure is an interesting feature in this regard. Centrifugal blowers are employed to send the gas from the Valby works to the western works, whence it is distributed to the city. There are many points attractive, but of minor importance, unless it be one among many generous considerations to the workman—viz., that the retort-house men are provided with free beer and soda water, whether limited or otherwise is not stated. The new works, by the way, cost complete to the present stage of development £320,000. The paper was illustrated by some beautiful lantern slides, which were greatly admired.

At the Franco-British Exhibition.

The scene of the meeting was changed to the Congress Hall at the Franco-British Exhibition on Thursday morning; and the change was not altogether a good one. The exhibition authorities do not appear to be overburdened with consideration for their best patrons. Although the arrangements for the meeting had been made two or three months before, there was no preparation for it first thing in the morning. The chairs had not been provided in the hall; and, when they were, they were in a dusty condition, and the floor was in a filthy state. Apparently the latter had never made the acquaintance of a broom. To the full, the hall tested the vocal powers of speakers, as well as the hearing capacity of listeners.

However, when the proceedings could be resumed, the discussion on Mr. Irminger's paper formed the first item in the day's programme. It was not a paper that lent itself to any lengthy criticisms; but its value and admirable character were commented upon. The speakers were Mr. J. Ferguson Bell, Mr. Thomas Canning, and Mr. S. Y. Shoubridge. Having regard to first cost, Mr. Bell thought it would have been cheaper to have adopted, in the scheme for motive power, gas-engines instead of electric motors; while Mr. Canning, scoffing at sentimentalism, saw advantage in employing electric motors, with the current generated by gas-engines. For the work to be performed in gas manufacturing operations, gas-engines are, in his judgment, more expensive and inconvenient than electric motors. Why did not Mr. Irminger adopt vertical retorts? was an inquiry put by Mr. Shoubridge. The answer was simple. The plans were finished and the work was carried out before vertical retorts had attained their present status; and as to gas-engines *versus* electric motors, in such operations as are performed in gas-works, the questions of gearing and attendance are important matters. It is perhaps in gas-works preferable and more economical in labour to concentrate attendance at one point, and that at the generating plant. This is the opinion of those who have adopted such plants.

Extraction of Cyanides and the Manufacture of Yellow Prussiate.

Thoughts were diverted by Mr. Edward Allen, of Liverpool, into an altogether new channel. He has been gathering experience in the extraction of cyanides and the manufacture of yellow prussiate by the Davis-Neill process at the Linacre works of his Company; and, in a short paper, he tells us of what the process consists, and something as to its working. It was an interesting little contribution, although the subject cannot be expected to arouse much enthusiasm—especially when the author almost at the beginning tells his hearers that at present, in common with the general shrinkage of demand for all manufactured products, the sale of prussiate has met with a check, especially in the American markets, and prices are consequently at a low level; and then to emphasize the matter winds up the paper with the statement that it cannot be said that the present condition of the market encourages the adoption of cyanide plants on gas-works. It is evident that the supply of prussiate exceeds the demand; and the right policy appears to be restriction until the balance is adjusted. However, the Liverpool Gas Company and Mr. Allen are so pleased with the twenty-months' trial run that was made of the Davis-Neill plant at the Linacre works that they took it over from the makers on prearranged terms. Therefore, when the market is opportune for other makers to adopt a cyanide plant, the experience at Liverpool, and the interesting description given by Mr. Allen at this meeting, will bring the Davis-Neill plant favourably to memory; and those who have seen the beautiful crystals developed by the process, as did the members of the Manchester Institution of Gas Engineers towards the close of last year when visiting Liverpool, will not forget the good impression they made. The plant in use at Liverpool has a capacity equal to the treatment of 3 million cubic feet of gas, or about 270 tons of coal per day. Mr. Allen's description of the process is so brief that it is altogether unnecessary to extract its points here, each one of which forms an indispensable link in a complete chain of operations, so that separation without injury to sequence and comprehension is impossible.

The tightness of the market for the products of cyanide recovery cause producers to be a bit chary about publicly giving exact figures on any matter appertaining to it, excepting on the point ascertainable by all, that the market price of the product has had an immense fall. Look through the report of the remarks of Mr. D. Irving, Mr. J. H. Brearley, Mr. J. Ferguson Bell, Dr. Colman, Mr. Alex. Wilson, and Mr. P. S. Hoyte, and uncertainty or indefiniteness prevails; but costs of installation and working can always be obtained privately. It is said that the experience has not been a happy one for those who have gone in for cyanide recovery; but, on the whole, we do not gather that any of them are contemplating relinquishing their operations in this respect, notwithstanding the enormous drop in price, since the days when gas-works entered into this business. There is no doubt, from the outlook, that all fresh entrances in manufacture make things worse for those already engaged in the business, and do not do much good for those who are newly adopting the system. Glasgow does very well with cyanide cake; they have not gone to the length of crystallizing the product. They started working in the early days; and those who started then, like Glasgow, have the best of the bargain, in that they have been able to wipe off their capital charges in times of good market values. Such troubles as are, or have been, experienced with the system seem to be more of a mechanical than a chemical character. Acknowledgment was made of the invaluable work that Dr. Colman has done in connection with cyanide recovery. The subject is one that has not of late been dealt with at the meetings of the Institution; and the paper read by Mr. Allen and the

discussion present many points that should be carefully considered by anyone contemplating the adoption of any cyanide-recovery process.

The Gas Section Exhibit.

Before the last paper was taken, Mr. J. W. Helps called attention to the work of the Gas Section Committee; and to the expenditure that has been incurred. It is obvious, from what he says, that the Committee can do with more money, for pursuing their effective work, by advertising the exhibit. Gas undertakings who have not contributed will please note. The influence of the exhibit, as a demonstration of the abilities of gas, as his reported remarks will show, must extend to all parts of the kingdom.

Refractory Material.

This was the subject—a much-neglected one—of the last paper brought before the meeting. It was by Mr. F. J. Bywater, of Birmingham, who has made a special study of the question since the days of his pupilage. It is a reflection on the Institution that a paper dealing with the refractory materials that take such prominent part in carbonization structures should not have hitherto appeared in its "Transactions." The very fact suggests indifference; indeed, this is one of those subjects on which the technical literature is altogether inadequate to its importance. Mr. Bywater gives us an excellent compendium of a big subject; and he deserves thanks for it. There never was a time in the history of retort-bench construction when, with the higher temperatures of carbonization, and the development of new carbonizing plants, a systematic investigation of the materials employed in their building has been so requisite as now, both by manufacturers and gas engineers—in fact, when the materials employed in the settings by the latter should be as thoroughly tested as the raw material carbonized in them. Notwithstanding the greater strain now brought to bear upon the retort material through the higher temperatures and the altogether different treatment to which it is subjected, there is grave doubt in Mr. Bywater's mind whether, on the whole, the quality of the material has generally improved.

The author does not deal with the manufacture of refractory materials, but confines himself entirely to the aspects of his topic which affect the gas engineer. Even so, the paper is long—not too long for its purpose; but it is impossible to do more, in a summary such as this, than point to the lines the author took. He treated first upon the origin of fire-clays, around which there has been much wordy warfare, and from which Mr. Bywater extracts, in brief, the most reasonable explanations and hypotheses. He then discussed the chemical and physical composition of fire-clay. In this connection, censure is meted out to the fire-brick manufacturers for their perpetuation of very primitive methods in the testing of fire-clays. The author deduces from his own research and that of Dr. W. B. Davidson (also of Birmingham), that the ultimate analyses of a clay, as usually employed, are of very little use in arriving at a proper estimate of refractoriness, and far better knowledge is based upon mechanical and rational methods for subdividing the material into its various mineralogical constituents, when ultimate analyses may be employed. Having arrived at a true knowledge of the constituents of the clay on these lines, samples and mixtures may be tested with success in a practical way in a small furnace of a kind that Dr. Davidson has adapted for such work for use with coal gas, or one of a modified Deville pattern, in which a good hard coke is used. The author prefers the latter, as it more nearly approaches the conditions of a working test.

The finished product from the fire-clays is next discussed; and many notable points are made. In the summing up of this section, it is concluded that it is quite impossible to form a correct judgment of the refractoriness of a fire-brick by its colour, although, after considerable experience of the clay goods of any district, it is possible for a practical man to give an approximate opinion of the value of a brick from the appearance of its fracture, providing it is well burnt. Hard, clear ringing, heavy, well-burnt bricks usually prove most refractory and serviceable, other things being equal; and impurities can at all times be more easily detected in a well-burnt brick than in a lightly burnt one. It is an essential that bricks, during the process of burning, should always be subjected to as high a temperature as they will be required to withstand in the work. Unless this is done, subsequent shrinkage may occur. Highly silicious fire-clays, silica quartz rock, and black ganister are next treated upon; and then the author passes to the practical testing of refractory material. Chemical analyses afford much information; but they should be accompanied by practical tests conducted so as to approximate, if possible, working conditions. Of course, fully reliable information as to the refractory qualities of material can only be obtained by continuous testing at high temperatures under working conditions; and extensive purchases of material of which little is known should not be undertaken unless a few of the bricks have been tried for at least a season in the cross walls of a retort-setting or in some such situation. But for preliminary and also comparative tests, at the time of the settlement of contracts, a testing furnace of the type proposed by Dr. Davidson, or else the modified Deville form, should be used.

The importance of the design and selection of refractory material is next commented upon by the author. In his opinion, all classes of refractory goods should be made of moderate size; large blocks and tiles being eschewed. But why attempt a digest of this section of the paper. Every line contains a hint or suggestion. From among them all, the fact is picked out that Mr. Bywater has a preference for segmental retorts—their life, with gaseous firing and high heats, being from 1400 to 1600 days, while the average life of moulded retorts of ordinary fire-clay is from 700 to 800 days. For segmental inclined retorts, the former figures are somewhat less. Machine-made retorts, the author is certain, are rarely so satisfactory as hand-made ones. The retort makers will rub their eyes to read that what is urgently needed is a retort which will give a life of 2000 to 2500 days, be moderate in price, and be readily obtained. And they will meditate very seriously over the castigation administered towards the end of the paper for allowing German makers to supersede them in quality and commerce, solely through research methods that are scientific and not primitive.

In the discussion, there was a chorus of acknowledgment of the ability of the author in dealing with this subject, and of the immense value of the paper. There is approval found in the remarks of the President, Mr. H. W. Woodall, Mr. Charles Carpenter, Mr. W. C. Jones, Mr. H. Kendrick, Mr. J. W. Morrison, Dr. H. G. Colman, Mr. Thomas Glover, Mr. Douglas Helps, Mr. Alex. Wilson, and Mr. Vincent Hughes. This list shows the extended interest that the paper elicited. Several of the speakers endorsed the warnings of the author that the German manufacturers of fire-clay goods are putting this country into second place; and the credit is given to improved technical knowledge and education. It is believed that the British manufacturers of fire-clay material are now realizing their own deficiencies. Mr. Jones, coming from the Stourbridge fire-clay district, stood up for the makers. They are not, in his opinion, so bad in their productions as is represented. Dissatisfaction is, he contends, partly due to the purchaser in not saying what he wants the material for, and what is the temperature to which it is to be subjected. There is no doubt there is good fire-clay material in the Stourbridge district; it only wants to be dealt with in a more scientific manner. The weathering of the fire-clay is a point that Mr. Wilson says is an important one in getting a good and durable product. Dr. Colman confirmed the opinion of the author as to the absolute futility of the ordinary fire-clay analyses, without consideration of the manner in which the constituents are combined, and without regard to their mechanical and physical characteristics. Such analyses cannot be made very well by gas-works; but in gas-works, systematic testing can be carried on in furnaces. Segmental retorts received good recommendation for longevity; but Mr. Douglas Helps thinks this is due to the easier repair that they allow. Improvement in production of the moulded types, it is believed, would soon displace segmental retorts, which are somewhat more costly. Mr. Kendrick and Mr. Vincent Hughes were supporters of machine-made retorts in comparison with hand-made ones. It was suggested that on this matter the Society of British Gas Industries might arrange a conference between the section of their body dealing with fire-clay goods and the Council of the Institution, in order to discuss the very important points raised in Mr. Bywater's paper.

The End of the Business Proceedings.

Only formal business had now to be transacted to relieve the members from technical proceedings which will—through the subject-matter of the papers—be accounted among the

most interesting in the annals of the Institution. The Scrutineers (Messrs. Bower and Belton) of the balloting-papers reported the election of Mr. Thomas Glover as the President for the ensuing year. Nothing can be said in praise of Mr. Glover that the members would not most heartily endorse. Mr. Alexander Wilson, of Glasgow, it was heard with unfeigned satisfaction, had been united with Mr. James W. Helps in the vice-presidency. The President of the Société Technique, and that zealous worker in the theory and practical development of the gas-engine, Mr. Dugald Clerk, were elected to honorary membership. London was selected as the place of next year's meeting, with possibly an excursion to Norwich; and then votes of thanks fell copiously. So ended sittings of memorable character.

GENERAL REPORT.

The Annual General Meeting of the Institution was opened last Tuesday morning, at the Institution of Mechanical Engineers, Storey's Gate, Westminster—Mr. W. Doig Gibb, M.Inst.C.E., the President, in the chair. There was a good attendance of members.

Confirmation of Minutes.

The minutes of the last annual meeting, held in Dublin, were taken as read, and confirmed.

Appointment of Scrutineers.

Mr. T. Bower (West Hartlepool) and Mr. J. C. Belton (Chester) were appointed Scrutineers of the ballot-papers.

The Annual Report.

[See "Journal" for June 2, p. 556.]

The report of the Council having, as usual, been taken as read, it was unanimously adopted.

The London Medal.

The President said the particulars of the awards of medals were included in the Council's report; and he had much pleasure in presenting the London Gold Medal to Mr. J. H. Brearley, of Longwood, for his paper on "The Testing and Hygienic Efficiency of Gas-Fires."

Mr. Brearley said he could not express in words his appreciation of the honour done him by the Council; but he should take it as a commission to do what he could in future to further the interests of the industry in general and of the Institution in particular.

The Institution's Medals.

The President presented the Institution's Silver Medal to Mr. F. W. Goodenough, for his paper on "The Sale of Gas;" and the Bronze Medal to Mr. A. G. Glasgow, on behalf of Mr. R. M. Searle (of Rochester, New York), for his paper on "High-Pressure Distribution Development in the United States." He said Mr. Searle had written from America to say that he could not attend personally, but could not receive the medal through a more acceptable channel than Mr. Glasgow, to whom he was indebted for his first instruction in scientific engineering.

Mr. A. G. Glasgow, in accepting the medal, remarked that, if he could not earn a medal on his own behalf, he could at least thank the Council for the compliment of asking him to receive the one awarded to Mr. Searle.

The President's Address.

The President then delivered his Inaugural Address, which was given in the "Journal" last week (p. 687). At its close,

Mr. Charles Hunt (London) moved a cordial vote of thanks to the President for the eminently able and practical address to which the members had listened with so much pleasure. Mr. Gibb had drawn freely on his own experience, and produced an address which would rank among the most valuable in the "Transactions" of the Institution. They were especially grateful to him for his appropriate observations on the Miners' Eight Hours Bill; and he (Mr. Hunt) only hoped that, at the eleventh hour, what the President had said would have some effect. They were also very grateful to him for his reference to the Benevolent Fund, which reminded him of an omission of his own last year, when he undertook to mention it to the members, but did not find the opportunity to do so. He was very glad the duty had fallen into the President's able hands, and hoped the result would be a great increase in the contributions.

Mr. W. A. Valon (London) having heartily seconded the motion, it was carried by acclamation, and the President briefly responded.

Reading of Papers.

The reading of papers was then proceeded with. They were taken in the following order:—

Tuesday.—"Co-Partnership," by Sir George Livesey. "Recent Experience with the Dessau Vertical Retorts," by Mr. A. F. P. Hayman, of Berlin. "Continuous Carbonization in Vertical Retorts," by Mr. H. W. Woodall, of Bournemouth.

Wednesday.—"Description of the New Gas-Works at Valby, Copenhagen," by Mr. J. O. V. Irminger, of Copenhagen.

Thursday.—"The Extraction of Cyanides and Manufacture of Yellow Prussiate, by the Davis-Neill Process, at the Linacre Gas-Works, Liverpool," by Mr. E. Allen, of Liverpool. "Refractory Material," by Mr. F. J. Bywater, of Birmingham.

The papers, with reports of the discussions thereon, will be found in another part of the "Journal."

The Benevolent Fund.

On Wednesday, the annual meeting of the donors and subscribers to this fund was held. A report of the proceedings will be found on p. 786.

The Lecture, and an Explanation.

At the close of the Benevolent Fund meeting, Dr. W. A. Bone, F.R.S., Professor of Fuel and Metallurgy in the University of Leeds, delivered a lecture on "The Combustion and Thermal Decomposition of Hydrocarbons;" but we are unable to publish the text of the lecture this week (an indication of its trend appears in our "Review," p. 779) through circumstances which call for a little explanation to our readers.

For all time, when lectures have been delivered before the Institution, or its predecessors, it has been the invariable custom for the lecturer to, before or immediately after, hand a copy to the Press; but no intimation was made, prior to the lecture, that this would not be done on this occasion. Otherwise, we should have taken steps to have had the lecture reported. Far from any such intimation being given, an application was made, by letter, to Professor Bone before the meeting for the MS. of the lecture; and a reply was received from him upon the meaning of which only one construction can possibly be placed—that it was his intention to bring the MS. to the meeting on Wednesday, and that it would then and there be available for our use. This is Professor Bone's reply (dated June 11) to our application:

> **I am afraid my MS. for the lecture next week is not yet ready. I have had so many important and urgent calls on my time during the past two or three weeks, that I have been quite unable to prepare my MS. I am hoping to get a clear week-end at it,** *and to bring it up with me to London. I am very sorry; but this is the best and the utmost I can do for you.*

Professor Bone regards himself under no obligation in view of his letter which misled us into a feeling of security regarding the possession of the MS. directly after the delivery of the lecture. The reason Professor Bone gives for not handing over the MS. is, as we understand it, that he was engaged to deliver the same lecture before the Chemical Society the following evening, and that, without the consent of the Council of that Society, he could not part with it for publication before it had been published by them. Why he did not say so in the reply reproduced above is not explained. It will be a new thing if the Council of the Institution of Gas Engineers are to submit to the time and place of publication of lectures for the delivery of which they pay, being subservient to any generosity on the part of the Council of another Society. So far as we are aware, there was no reservation of this kind by Professor Bone when the Council of the Institution retained him for the delivery of the lecture; and he has made it is a departure from custom that it is hoped the Council will not permit in future. Professor Bone is,

we understand, trying to secure the consent of the Chemical Society to its early publication in the technical gas papers. Meantime, we leave the above letter and Professor Bone's action to the judgment of our readers. However, the text of the lecture, if the Council of the Chemical Society charitably allow it, shall be published as early as possible. The position is, to say the least, a peculiar one.

At the close of the lecture,

Sir GEORGE LIVESEY, in proposing a vote of thanks to Professor Bone, said his first word must be one of gratitude to him for introducing a new term in connection with gas, because he had three times used the words "aromatic hydrocarbons;" and as he had been enjoying the aroma of a well-known hydrocarbon during the lecture, he thought it was well to remember that their gas was aromatic. They had heard a most interesting lecture; but he feared it was rather beyond most of them—at any rate, he must confess that it was beyond him. He was brought up to understand that gas consisted of hydrocarbons, carburetted hydrogen, marsh gas, and one or two other constituents; but they now found that it was a very complicated affair. It was hardly likely that the originators of gas manufacture could have hit upon exactly the right method of producing illuminating gas from coal. It was really a wonder that they had done so much. But this was the work of engineers; and now the scientific chemist had to step in. They found a difficulty in producing from coal the gas which Parliament required or authorized them to make. Those who had to supply 14-candle gas could not produce it from coal, though they could do so by a mixture with another and totally different gas; and the problem before them was to produce the largest quantity of gas of low nominal illuminating power from coal. Engineers of large companies had more than enough to do in other directions, so that it was quite out of their power to undertake these investigations; and he doubted whether the smaller companies could do much either. Here, however, they had Professor Bone, who had been appointed Professor of Gaseous and Solid Fuel at the Leeds University; and they had seen and heard enough from him that morning to convince them that they must look to the University and others like it—if there were any—to do this work for them. He (the speaker) had recently taken up the *rôle* of a beggar, for which he was not very well suited, and tried to get £500 a year for the University; but he had stuck at £388. The Leeds Corporation Gas Committee gave £100, the Gaslight and Coke Company £100, the South Metropolitan Gas Company £100, the Commercial Gas Company £30, Mr. Jones got £10 from the Wandsworth Gas Company, the Newcastle Gas Company gave £20, the South Suburban Gas Company £20, the Dartford Gas Company £5 5s., and Mr. J. Holliday, of Hull, gave £3 3s. on his own account. He now wanted to hand over this work to the Institution. A fairly good start had been made; and he thought the gentlemen present might between them make up the sum still required. He thought if the Institution undertook the work, and Mr. Dunn collected the money annually, and handed it over to the University, it would be a good and useful thing to do. The Institution had already shown their interest in the Leeds University by founding a scholarship; and this would only be an additional link.

Mr. THOMAS GLOVER (Norwich), in seconding the motion, said it must have been very gratifying to the lecturer to see facing him so many seekers after truth. They were all very anxious to know the truth with regard to the decomposition of hydrocarbons at different temperatures, especially in conjunction with surface action; and though they might not be able straightaway to apply what they had heard to the operations they conducted from day to day, he had no hesitation in saying the lecture would lead on to a further study by the members (and more especially by the members of the Junior District Associations), that the results shown would be boiled down and applied to them and served up again, and that they would be able to reap great benefit from the results which Professor Bone had demonstrated to them. At one time gas engineers were more particularly interested in the decomposition of the hydrocarbons in a luminous flame; but at the present moment they were chiefly interested in the decomposition which took place in the retorts, because the introduction of vertical retorts had demonstrated that they had been losing in the volume of gas by the decomposition and the formation of free carbon. It might be that the vertical retort was not at present a perfect instrument—that it was not bringing about sufficient decomposition, or decomposition in the very best form. But all this they would hope to learn more about in the days to come, and he felt pretty certain in the immediate future. It was very interesting to have a lecture of this kind, and to see the care and skill bestowed on the elucidation of these problems; and they were deeply indebted to Professor Bone for putting the matter so clearly before them. He hoped Sir George Livesey's suggestion would be carried out, and that they would ally themselves with the Leeds University; for he felt quite certain that it would be to their mutual advantage.

Mr. H. E. JONES (London), in supporting the motion, said if they were really true lovers of science they would not only appreciate the lecture, but also the action of Mr. Holliday, who had set such a good example by contributing individually to the support of this work. He hoped that many would contribute individually, as he should himself. But apart from this, they should all use their influence with those for whom they worked, and point out that it was their duty to have these important questions investigated in a manner which was only competent to outside workers. When people talked to him about inventing things, as Mr. Woodall had done, his reply was that his hands all his life had been so full building and pulling down, altering, extending, finding capital, and so on, that he had had no time for anything of the sort. But on every occasion when he had seen a retort scurfed, and a great mass of solid carbon extracted, he had regretted that he could not spare time for investigating the matter, and finding out why there should be this loss. He hoped they would all go back to their respective companies and corporations and obtain subscriptions for the University of Leeds, which had already borne such good fruit.

The PRESIDENT, putting the motion, said he should like to add just a word or two. In connection with the Research Fund, the Institution had practically recognized that it was impossible in many works to conduct elaborate chemical experiments; consequently they devoted the money they received for the special fund to the carrying out of work such as that of which they had just had so splendid an example. Professor Bone was actually in charge of the Fellowship which the Institution had founded in Gaseous Fuel in Leeds University, and was guiding their scientific research; and he was sure they would all agree that no one could be more competent. In addition to this, the Institution, through one of its Committees, was making considerable researches into heating by gas; and Professor Bone was on the Committee managing the experiments.

The vote having been carried by acclamation,

Professor BONE said he very much appreciated the kind things which had been said, not only about the lecture, but about the work he was doing in general. It was very pleasant indeed to him, almost at the outset of his work at Leeds, to be brought face to face with so many representative gas managers. The lecture they had listened to and the experiments they had seen were the outcome of a great many years of investigation. This sort of thing was not done in a day, or a month, or even a year. That was a point on which many practical men rather misunderstood the scientific man. The whole of this research had been conducted primarily as a scientific investigation, without any ulterior motive whatever, though it had important applications. It had been attacked solely as a scientific problem; and no consideration under the sun would induce him to deviate one hair's breadth from this position. But one could not conduct researches of this kind, and in this way, except with the expenditure of a large amount of time and energy. The arrival at truth was a slow process, if the progress made was to be sure; and this applied perhaps more in the realm of physical science than in any other branch of human activity. Therefore with all the warmth of their welcome, which appealed to him very strongly, he would ask them to remember this: They would certainly not every year get a crop of results such as they had just listened to, which were the outcome of about ten years' work. It could not be done, not if they subscribed £50,000, instead of £500. One could not hurry this sort of work. He therefore asked them, not only for their generous support in carrying out scientific work which had a direct application to their industry, and which in the long run would be of great benefit to it, but also for their patience and sympathy in examining the results, which were only slowly, if surely, accumulating. Secondly, he would remind them that the Leeds University had started this new department

as a sort of bold venture. It was started before he went there, and was due to the initiative and enthusiasm of their friend Professor Smithells. The project was initiated really before any appeal was made to the industry to which it intended to look; and an Institution which would do a thing of this kind, which had sufficient faith in the necessity and fruitfulness of such a venture, would have the necessary moral enthusiasm, if the material support could be found, to carry it to a successful result, whoever might be the person to whom the task was entrusted. He put forward no personal claim. He had spent a good many years in scientific research, and did not know what the future might have in store for him; but the work in Leeds which had been now begun would, he hoped, be continued through years and years, to the great benefit of the industry which they represented. He trusted that, whether he or someone else had charge of it, they would give him liberal support, both material and moral; and it was the latter which was most important, and the chief factor in success.

On Thursday morning, the members assembled at half-past ten o'clock in the Congress Hall at the Franco-British Exhibition.

The PRESIDENT opened the business by inviting discussion on Mr. Irminger's paper (see p. 817).

The Gas Section of the Exhibition.

At the close of the discussion on Mr. Allen's paper,

Mr. J. W. HELPS said he should like to say a few words to the members with regard to the Gas Section of the Exhibition, which they were to visit in the afternoon, especially as when they went there it would be very difficult to have anything in the nature of a "personally conducted tour." The place was not very large; and it would be impossible to explain anything on the spot. He would, therefore, briefly state that, in setting about this work, an influential Committee was formed, and they thought the best thing to do at the outset was to practically confine their efforts to making such a display as would indicate to the general public what really could be done by means of gas for lighting, cooking, heating, and various other purposes. He must honestly say they had hoped the other side of the business would come in to a greater extent than it had done, and that more space would have been taken up in showing the improvements in the manufacturing line. So far, they had done something. They had put up a series of apartments well furnished and properly lighted and heated; and there was a very pretty display of the possibilities of gas. The members would also notice that a certain amount of space (but not very much) was given to industrial matters. However, he thought the laundry attracted as much attention as anything in the Exhibition. The same could be said for what was done in the way of cookery demonstrations; and they had mantle-making and other points of interest. One block was unoccupied so far; and, on behalf of the Committee, he must apologize for it. It was only because they had been hoping for some time to get Messrs. Kempton to put up an exhibit of glass-making, showing how gas could be utilized for melting glass, and also how the glass, when melted, could be turned into articles of use—in many cases in connection with their own industry. But the experiments carried on by Messrs. Kempton had not yet been finished; and, in addition, they had had extreme difficulties with the authorities in allowing them to put up a little annex outside in which the furnace could be erected, as it was impossible, on account of the heat and noise, to put it inside. This, unfortunately, was not the only point in which difficulties had arisen. There was great apathy on the part of those in authority; and the Committee could not get them to pay anything like proper attention to the very reasonable requests they had made from time to time. The Gas Section of the Exhibition had cost a great deal of money. The space occupied alone cost over £1100; and the Committee had spent nearly £2000 erecting and furnishing the buildings and a considerable sum in fitting them up. It would therefore be seen that the £4000 collected from the gas undertakings which had been kind enough to help, would not go very far. They would all agree that this was important, as they wanted to do a good deal in the way of advertisement and in the preparation of pamphlets and leaflets to distribute to the thousands of people who called daily. He did not think there was any other exhibit which attracted more attention. He understood that some people in the country said they did not see why they should be called upon to subscribe to an undertaking such as this, because their companies were so far away from London that it could not possibly be of much real benefit to them. But he ventured to differ entirely from this view, and he had a paper in his hand which would disprove such a suggestion. The place had been open only a very short time, but he had three sheets pretty nearly filled with the names of places all over the country—England, Scotland, and Ireland—the people living in which had visited the exhibit, and had made a series of inquiries, which their officers had instructions to send on direct to the companies in the towns whence these possible customers came, giving full details of their requirements, and suggesting that they should be communicated with at once. After reading a long list of places, Mr. Helps said they had sent to the gas companies in all these towns suggesting that they should take the matter up; and he asked members who represented gas companies who had not already subscribed to help the Committee in this effort, and try to convince their directors that it was not necessary, in order to benefit by the Gas Section of the Exhibition, that they should be living on the spot. It was very probable the earlier benefit would accrue to those who did; but finally what was good for London would be good for the country generally. Another apology he had to make to the members. It had taken him, as the Honorary Secretary of the Committee, some time to point out to the authorities that it was only fair that they should grant permanent passes or season tickets to representatives of the companies who had subscribed to the fund. He had written letter after letter, and had interview after interview; but it was only lately that he could get them to acknowledge the fairness of the suggestion. When they did, they promised that every company who had subscribed £10 should have one permanent ticket, and two should be given to every company who had subscribed £100, with the proviso that the representatives should send up their photographs. Some had already done this, and he sent them on immediately to the authorities to prepare the tickets; but he did not think anybody had yet received one. He had that morning had a small bundle of about two dozen given to him, and gentlemen might apply to see if theirs were included. He must apologize for the delay; but he could assure the members that it was not due to any want of effort on his part.

The New Officers.

At the close of the technical business,

The PRESIDENT announced the result of the election of office-bearers for the current year, as follows:—

President.—Mr. Thomas Glover, of Norwich.

Vice-President (in association with Mr. James W. Helps, of Croydon, elected last year).—Mr. Alexander Wilson, of Glasgow.

New Members of Council.—Mr. E. Allen, Mr. Joseph Davis, Mr. Timothy Duxbury, and Mr. Lawrence Hislop.

Auditors.—Mr. James L. Chapman, and Mr. Samuel Wood, F.C.A. (Messrs. Wood, Drew, and Co.)

The PRESIDENT also announced that all the candidates for membership of the Institution had been duly elected. The following is the list:—

MEMBERS.

Atkinson, H. J., Engineer and Manager, Hawera Gas-Works, New Zealand.
Bell, A., jun., Engineer and Manager, Peebles Gas-Works.
Blair, W., Engineer and Manager, Helensburgh Gas-Works.
Brook, A. S., Engineer, Manager, and Secretary, Chard Gas-Works.
Bruce, H., Manager, Inverurie Gas-Works.
Bywater, F. J., Works Engineer, Saltley Gas-Works, Birmingham.
Cunningham, A. M., Manager, Kilmalcolm Gas-Works.
Davey, A. E., Engineer, Manager, and Secretary, Aberdare Gas-Works.
Dickson, J., Manager, Kelty Gas-Works.
Easson, W. S., Engineer and Manager, Jedburgh Gas-Works.
Farquhar, W. B., Engineer and Manager, Ilford Gas-Works.
Galleway, W. M., Manager and Secretary, Whitby Gas-Works.
Hill, J. H., Manager and Secretary, York Gas-Works.
Keillor, J. D., Engineer and Manager, Lochgelly Gas-Works.
Lomas, R., Engineer, Rosario (Santa Fé) Gas-Works, Argentina.
Marshall, W., Manager and Secretary, Banff Gas-Works.
M'Geachin, J. G., Engineer, Manager, and Secretary, Dumbarton Gas-Works.

Moon, P. G., Assistant Engineer and Manager, Bournemouth Gas-Works.
Power, J., Superintendent, Neepsend Works, Sheffield Gas Company.
Rapkin, F. W., Engineer and Manager, Dartford Gas-Works.
Readdie, P. L., Manager and Secretary, Leven (Fife) Gas-Works.
Readdie, W. G., Engineer and Manager, Anstruther Gas-Works.
Reid, A., Engineer and Manager, Brechin Gas-Works.
Ritchie, W., Engineer, Manager, and Secretary, Peterhead Gas-Works.
Scott, J. B., Manager, Cowdenbeath Gas-Works.
Simpson, R., Engineer and Manager, Cambuslang Gas-Works.
Stevens, J. R., Manager, Elie Gas-Works.
Stewart, J., Engineer and Manager, Lanark Gas-Works.
Tanner, C., Superintendent, Gillingham Works, Rochester Gas Company.
Thomson, A., Engineer and Manager, Inverness Gas-Works.
Turner, H. R., Engineer and Manager, Ashford (Kent) Gas-Works.
Watson, P. B., Engineer and Manager, Wishaw Gas-Works.
Wynne, J., Engineer and Manager, Carnoustie Gas-Works.

ASSOCIATE MEMBERS.

Gill, G. M., Assistant-Manager, Poplar Works, Commercial Gas Company.
Hammond, W. W., Engineer and Manager, Bognor Gas-Works.
Head, W. G., Engineer's Assistant, Vauxhall Works, South Metropolitan Gas Company.
Hills, H. F., Chemist, Commercial Gas Company, Stepney.
Harston, V. E., Chief Assistant Engineer, Norwich Works, British Gaslight Company.
Ibbotson, S. W., Engineer and Manager, Newport (I.W.) Gas-Works.
Taylor, F. W., Assistant Engineer, Shanklin (I.W.) Gas-Works.

ASSOCIATES.

Liberty, W. J., Inspector of Gas Lighting to the Corporation of the City of London.
Smith, A. G., Superintendent, Corporation Gas and Lighting Department, Liverpool.

Mr. GLOVER said he could not pretend to find words to adequately express his thanks for the great honour conferred upon him by his election as President, which had come at least ten years sooner than he could reasonably have expected. He hoped, however, he should not disappoint the members. He supposed it was due to his zest in following out the work of his profession; and, as he knew they all had the same zeal, there would be plenty of candidates for the presidency in future years. He could only say that any ability he had would be brought to bear on the work of the Institution; and he would endeavour to do all he could to make it in the coming year as successful as it had been in the past and previous years.

Mr. WILSON also thanked the members for the honour conferred upon him, and said he should continue to do all that he could, as he always had done, for the interests of the Institution.

Honorary Members.

The PRESIDENT then nominated as honorary members of the Institution the President of the Société Technique de l'Industrie du Gaz en France and Mr. Dugald Clerk, F.R.S. He remarked that the members all knew Mr. Clerk so well that it was quite needless to say anything about him. His researches in connection with gas-engines and other matters had, in the opinion of the Council, made it eminently desirable that he should become an honorary member.

Mr. J. W. HELPS (Croydon) seconded the nominations, which were unanimously agreed to.

The PRESIDENT added that Mr. Dugald Clerk had wired to say that he valued most highly the honorary membership of the Institution, and that it gave him the greatest pleasure to know that the President and Council thought his work merited this distinction. He regretted that indisposition prevented his attending the meeting.

Votes of Thanks.

The PRESIDENT moved that the best thanks of the Institution be conveyed to the German Association of Gas and Water Engineers for their kind invitation to the members to visit Berlin, and for all that had been done by them and by the Imperial Continental Gas Association in view of the visit.

Mr. T. GLOVER (Norwich) seconded the motion; and it was carried unanimously.

The PRESIDENT next proposed a vote of thanks to the Council of the Institution of Mechanical Engineers for their kindness in granting the use of their room for the meeting.

Mr. S. GLOVER (St. Helens) seconded this proposition, which was carried unanimously.

Mr. C. STAFFORD ELLERY (Bath) moved a hearty vote of thanks to the Committee of the Gas Section of the Exhibition. He said that, whatever difference of opinion there might be, as Mr. Helps had suggested, as to the need for the Gas Section, it was quite certain that a great deal of time must have been devoted by the various gentlemen on the Committee to bring it to the condition in which the members saw it; and he must especially mention the name of Mr. Helps. He often wondered how Mr. Helps found time for all he was doing for the gas industry. They appreciated not only what he did, but the way in which he did it.

Mr. J. PATERSON (Redhill) seconded the motion, which was carried unanimously.

Mr. HELPS said this was an entirely unexpected honour; but at the next meeting of the Committee he would convey to them the thanks of the members. He had only a word to say in addition to what he had stated earlier—that he hoped the members would not make the mistake some people made in thinking the Gas Section was an exhibition of furniture instead of gas. He had heard several people remark, "What a strange thing it is to put a furniture exhibition in the Machinery Hall." For such an exhibit they were bound to have the rooms properly furnished; but in order to prevent the impression that was getting abroad, they had now removed some of the furniture, and left only sufficient to make the exhibit, as they hoped, effective. They might also consider that the rooms had too many gas-fittings in them, and that it was a bad advertisement to show that so many fittings were required. But here, again, it was necessary to make the exhibit attractive, and to put in a little more in the way of fittings than was really necessary. To those who stayed late enough to see the lighting of the grounds by gas, he might also say that the Committee had not very much to thank the authorities for. The columns which had been placed at their disposal for the high-power gas-burners were not so high as they ought to be; but the Committee could only alter them at considerable expense, to which they were not in a position to go.

Mr. J. W. MORRISON (Sheffield) proposed a vote of thanks to the President and members of the Council for their work during the past year. That they had done good work was evident by the results obtained in connection with the Miners' Eight Hours Bill and Workmen's Insurance, and the investigation carried out by the Carbonization Committee. In their President they had a man who with great ability upheld the dignity of the office; and he desired to thank him for his kindness in entertaining the members and their friends the previous evening.

Mr. A. E. BROADBERRY (Tottenham) seconded the motion; and it was carried by acclamation.

The PRESIDENT, in responding on his own behalf and that of the Council, said that if there had been any good done during the past year it had been probably due to the fact that they had been a united family. There had been no squabbling and no jealousies; they were all actuated by the common desire to do what they thought best for the Institution and the purposes for which it existed. If the members were really satisfied, the Council and he had their reward.

Mr. TIMOTHY DUXBURY (Oldham) proposed a vote of thanks to the authors of the papers, which, he said, had been quite up to the usual standard. Considering that so many subjects had been practically worn threadbare, it was pleasant to find that others were coming forward from year to year which were suitable for interesting treatment.

Mr. J. P. LEATHER (Burnley) seconded the motion; and it was carried unanimously.

On the motion of Mr. NORTON H. HUMPHRYS (Salisbury) seconded by Mr. CHARLES CARPENTER (London), a vote of thanks was accorded to the Scrutineers.

Mr. J. H. BREARLEY (Longwood) proposed a vote of thanks to the Hon. Secretary (Mr. Shoubridge). As a member of the Council, he said he had had every opportunity of seeing the work Mr. Shoubridge had done; and he did not think he need take up any more time than was required just to say that he had maintained the same amicable relations and the same high standard of work as had been set by his predecessor, Mr. Helps. One of his (the speaker's) great regrets in retiring from the Council was that he should

not now be brought so much into Mr. Shoubridge's genial presence as he had been during the past three years.

Mr. T. B. Ball (Rochdale) seconded the motion, which was carried unanimously.

Mr. Shoubridge, in responding, said he could assure all the gentlemen present that he had tried to prevent this resolution being brought forward. But he found there was one thing which even the Hon. Secretary could not do. At any rate, he had discovered that no Hon. Secretary was entitled to any thanks at the hands of the members, because the pleasure which came to him from his association with them far outweighed any services he could possibly render. At the same time, he received their thanks very gratefully. This gave him an opportunity of making a proposition which he knew they would receive with acclamation. They would all agree that no institution could possibly be served better than they were served by their Secretary, Mr. Dunn. No more zealous, capable, or enthusiastic Secretary ever served any body of men. A great deal of their success was due to his untiring efforts, his unvarying courtesy, and his tremendous powers of work; and he (Mr. Shoubridge) proposed a hearty vote of thanks to him.

The President remarked that, as he was just going out of office, and had had experience of working with Mr. Dunn for the past year, it was only appropriate that he should second the motion. They had in Mr. Dunn an ideal Secretary; and he hoped it would be long before they lost him.

The resolution having been carried unanimously,

Mr. Dunn said it was exceedingly kind of the President and the Hon. Secretary to speak of his services as they had done; but he was simply doing his duty to the Institution, as every man ought to do, in whatever position he found himself. It would be his endeavour to deserve the satisfaction the members had expressed. It would be untrue to say he did not work hard. But it was a great pleasure to work for those with whom he had come in contact.

Place of Next Meeting.

The President said the question of the place of meeting next year had been discussed by the Council the previous day; but he thought it would be well if Mr. Glover, the incoming President, would give his opinion on the subject.

Mr. T. Glover (Norwich) said this question had occupied a good deal of his thoughts; and, in deference to the wishes of some of the East Anglian members, he had had to consider whether it was possible or advisable that the next meeting should be held in Norwich. After thinking the matter over, he had come to the conclusion that it would not suit the convenience of members, or tend to give them a thoroughly good meeting, with a large attendance, if he asked them to come to Norwich. About a week or ten days ago, he received a very hearty invitation from Professor Smithells, of the Leeds University, to consider the question of Leeds as a place of meeting; and this had been discussed by the Council. His own feeling, after careful thought and consultation with friends, was that there was no place like London for their annual meetings. There were so many advantages connected with the Metropolis that they should only go to the Provinces when there was some special cause for it. It had been indicated that, in the ordinary course of events, they would probably be going to Glasgow in three years' time, and therefore he was of opinion that next year's meeting should be held in London. He might suggest an excursion to Norwich, where no doubt they would be able to provide some entertainment for the members.

Mr. D. Irving (Bristol) then moved that the next meeting be held in London.

Mr. E. Allen (Liverpool) seconded the motion, which was supported by Mr. Bell, and carried unanimously.

The proceedings then closed.

THE BENEVOLENT FUND.

The Annual Meeting of Donors and Subscribers to the Benevolent Fund was held on Wednesday morning—the chair being taken by the President.

The minutes of the previous meeting having been read and confirmed, the report of the Committee of Management was taken as read.

The President said there was only one point to which he need draw special attention, and that was the one he referred to in his address the previous day—the necessity for individual members doing all they could to press the claims of the Benevolent Fund. If they had in every District Association such an energetic worker as Mr. Charles Meiklejohn, a great deal of good would be done. He had managed to raise the contributions from his Association by £70 per annum; and if others could do anything like this, the funds available for the benevolent work of the Institution would be vastly increased.

Mr. J. Ferguson Bell (Derby) moved the adoption of the report, and congratulated the Committee on the large increase of subscriptions this year. Two years ago, he suggested that if the claims of the fund were brought more prominently before the members, there would be such an increase; and he was glad to find this had taken place. They all rejoiced in the results of Mr. Meiklejohn's action in the Midland Association; and he had no doubt that other Secretaries of District Associations were equally energetic, though the responses had not been so satisfactory. He would suggest that a circular be sent to the members giving some account of the work done, which he felt sure would have a good effect. During the past year, two cases had been brought to his notice in which the fund had been of great help. In one case provision was made for the widow and children of a man who had had no chance of making any provision for them; and in the other, a grant was made which was of great assistance in helping to tide over a very pressing need. The members only wanted to realize the great work which was being done, and he was sure they would be glad to subscribe according to their means.

Mr. Tim. Duxbury (Oldham), in seconding the motion, said the members in the Manchester district, mainly through the influence of Mr. Meiklejohn, had also had their sympathies stirred in favour of the Benevolent Fund. The matter had been brought before the Council on one or two occasions, and also before the general meeting; and he trusted that a fair measure of support would be forthcoming from the Manchester district. He would venture to suggest, now that the various District Associations were affiliated to the Institution, that some representation from them on the Committee of Management would be beneficial. There seemed to be a feeling that the members generally did not get all the information about the fund which they ought to have; but this would be greatly met if the Secretary or some representative from each District Association were connected with the Committee, and the number of subscribers would no doubt be increased.

The motion having been carried,

Mr. J. T. Jolliffe (Ipswich) moved the adoption of the accounts, which was seconded by Mr. D. Irving (Bristol), and agreed to.

The President next read the certificate of the Scrutineers, stating that Mr. C. Carpenter and Mr. Tim. Duxbury were duly elected members of the Committee of Management. He remarked that Mr. Duxbury would now be able to put his views directly before the Committee. He also had much pleasure in announcing the receipt of a letter from Mr. Henry Hack, of Birmingham, enclosing a cheque for £30 as a donation, and another from Mr. Cox, of Sunderland, enclosing a donation of £10. There was every hope, therefore, that next year the Benevolent Fund would be richer than it was to-day.

Special Meeting.

The President said the meeting would now be made special, for the purpose of appointing a Trustee of the fund, in place of the late Mr. W. J. Warner. They would all have read the appreciative references in the report to Mr. Warner, whom he had not enjoyed the privilege of knowing so well as many present; but there was no doubt that in his day and generation he did a very great deal for the gas profession and for the Benevolent Fund. It was necessary for them to appoint a new Trustee in his place. Mr. Corbet Woodall had been nominated, and had written saying that he gladly accepted the position, as he welcomed any opportunity of showing his continued interest in the Institution and in the Benevolent Fund. He (the President) did not anticipate there would be any other nomination; but it was necessary to formally appoint Mr. Woodall by resolution.

Mr. E. Allen (Liverpool) accordingly moved the appointment of Mr. Woodall.

Mr. J. Hepworth (Edinburgh), in seconding, said he only regretted that they could not insist on Mr. Woodall retaining the office as long as Mr. Warner did. But at any rate they might hope he would retain it for many years.

The resolution was carried unanimously; and this concluded the proceedings.

EFFICIENCY.

"TELEPHOS"

(Registered Trade Mark)

RELIABILITY.

PATENT DISTANCE GAS LIGHTER. NO PILOT LIGHT.

TURNS ON, LIGHTS, OR EXTINGUISHES GAS FROM ANY DISTANCE.

SUITABLE FOR

All kinds of Domestic Lighting, Hotels, Theatres, Clubs, Factories, Shops, Offices, Churches, etc.

Can be operated from any number of points at any distance apart.

ENTIRELY BRITISH MANUFACTURE.

Write for particulars to

TELEPHOS, Ltd.,

115-117, Cannon Street, LONDON, E.C.

Telegrams—KEYAGE, LONDON.

All Goods Carriage Paid.

ABOLISHES the Troublesome by-pass.

EASILY FITTED.

ABSOLUTELY RELIABLE.

Saves Mantles and Chimneys.

Suits existing Fittings and Decorations.

Pamphlet, Price List, and Showcards Free on application.

ENTIRELY BRITISH MANUFACTURE.

TELEPHOS is not a chemical Gas Lighter.

Immediate delivery from Stock.

Liberal discount to the Trade.

W. B. LAMPARD & Co.,

Gas and Cannel Coal Experts,

117-118, LEADENHALL STREET,

LONDON, E.C.

Telephone No. 13471 Central. Telegrams: "Lamparones London."

S. PONTIFEX & CO.

STREET LANTERN MANUFACTURERS, IRONFOUNDERS AND SMITHS,

REGNART BUILDINGS, EUSTON STREET, LONDON, N.W.

Telegraphic Address:
"ILLUMINATION, LONDON."

Telephone:
No. 10,581 CENTRAL (P.O.)

Please send for our Illustrated Catalogue of Street Lighting Requisites.

Samples and Estimates sent free on application.

THE "BETHNAL GREEN" LANTERN.

Fitted with **Cast Base** and **"Carpenter" Flashlight cock and tube,** or with ordinary scroll iron.

Can also be provided with cast brass roller trap for torch lighting.

As now being supplied by us to Hereford Corporation Gas Works. Order for nearly 600 received.

Makers of every description of Street Lanterns—made specially for use with Incandescent Gas Burners.

LAMP COLUMNS.

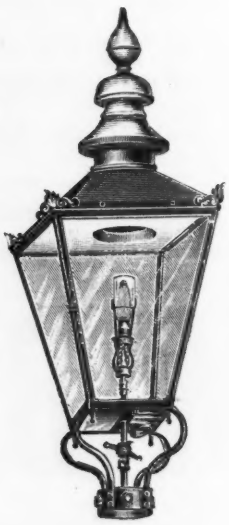
WROUGHT IRON WORK.

INCANDESCENT BURNERS.

LANTERN TAPS.

WROUGHT-IRON TUBES AND FITTINGS. . . . . .

All Public Lighting Requisites supplied.



THE "HORNSEY COUNCIL" LANTERN.

Many thousands of this, and other patterns of our manufacture, are in use throughout the country.

S. PONTIFEX & CO.,

REGNART BUILDINGS, EUSTON STREET, LONDON, N.W.

VISITS AND SOCIAL EVENTS.

On Monday as the members were assembling in London, the weather was brilliant, and seemed favourably disposed for the whole week. It continued its good behaviour on Tuesday morning, until the members were gathered together in the hall of their good friends, the Institution of Mechanical Engineers, when there was a downpour of rain. Thence until Wednesday morning, there were occasional heavy rains, and when it was not raining, Nature wore a sullen aspect, as though uncertain whether to be propitious or otherwise. But on Wednesday afternoon, fortunately, things atmospherical mended; and the members and their ladies were able to attend the reception by the President and Mrs. Gibb without the slightest inconvenience. The days were afterwards again brilliant, and so continued to the end of the week.

Of course, the great centre of attraction, when the members were at liberty was the Franco-British Exhibition at Shepherd's Bush. It appeared to have been unanimously voted the place to visit during leisure hours; and it was impossible to go there at any time in the afternoon or evening without meeting friends associated with the gas industry—and especially so was this on Thursday, when the morning sitting was held in the Congress Hall of the Exhibition, and the afternoon and evening were spent among the sights and gay and animated scenes of the magnificent show. But let us review the social events and visits in the order in which they occurred.

Masonic.

As has been customary for many years when the meetings of the Institution of Gas Engineers are held in London, the Evening Star Lodge, No. 1719, have arranged for an Emergency Meeting to be held, to give an opportunity to the members of the Lodge to welcome their friends from the Provinces. This year's gathering took place at the Restaurant Frascati on Monday of last week, the W.M., Bro. Glover Clark, being in the chair. The Wardens' chairs were filled by Bro. Jacques Abady and W.Bro. W. A. Surridge; the other officers present being: The Deacons, Bros. Cyril Davis and Wm. Edgar; the I.G., Bro. E. G. Smithard; the Organist, W.Bro. C. W. Offord; the Stewards, Bro. Thomas G. Marsh and W.Bro. A. E. Croager. The I.P.M.'s chair was filled by Bro. Walter T. Dunn; the D.C. being W.Bro. F. W. Cross. The Secretary and Treasurer also present were W.Bro. H. J. Davis and W.Bro. W. D. Child. After transacting the business of the Lodge, there was a banquet, followed by a smoking concert. Altogether some 150 members were present in the course of the evening.

The Reception.

In saying the reception by the President and Mrs. Gibb on Wednesday evening was a success unexcelled in the history of Institution receptions, no one will, it is certain, gainsay the statement. Charming were Mr. and Mrs. Gibb as host and hostess; and gracious was their reception of each individual guest. The reception was held in the well-known and convenient galleries of the Royal Institute of Painters in Water Colours, Piccadilly. The works of art that adorn the walls of the galleries are always worth inspection; but, with 272 guests (among them witnessing the profession's honour to their son, being the father and mother of the President), one found it difficult, so many were the old and new friends, to spare time, or to give much thought, to the pictures. Not all of our readers perhaps are aware that the President's father, Mr. J. S. Gibb, is Treasurer of the Edinburgh and Leith Gas Commissioners. The reception continued from eight to nine o'clock; and during that hour, lively music was discoursed by the band at one end of the largest of the galleries. Meantime, many of the younger members of the large company, and some of more mature years, among them a Past-President—"past" by some four years—were busily engaged filling their dance programmes. Thenceforward until 11.30, the dance-room was the scene of much animation. The heat did not cause the ardour of the dancers to flag. They gyrated to the lively strains of the band as though there was no such pleasure on earth as rapid motion in the month of June. Between the dances the adjoining room with its generous provision of light refreshments, was resorted to by the merry throng, and those of their friends who were indulging in the more staid occupation of friendly converse. There was the smoke-room, too, where the men were privately indulging, as though the technical sittings of the week were not enough, mostly in talking "shop." However, they were happy. But for all, merriment and happiness, under such circumstances and in such surroundings, must have an ending; and about 11.30—the time seemed all too short—the company parted from host and hostess. They carried away with them recollections of a very happy evening.

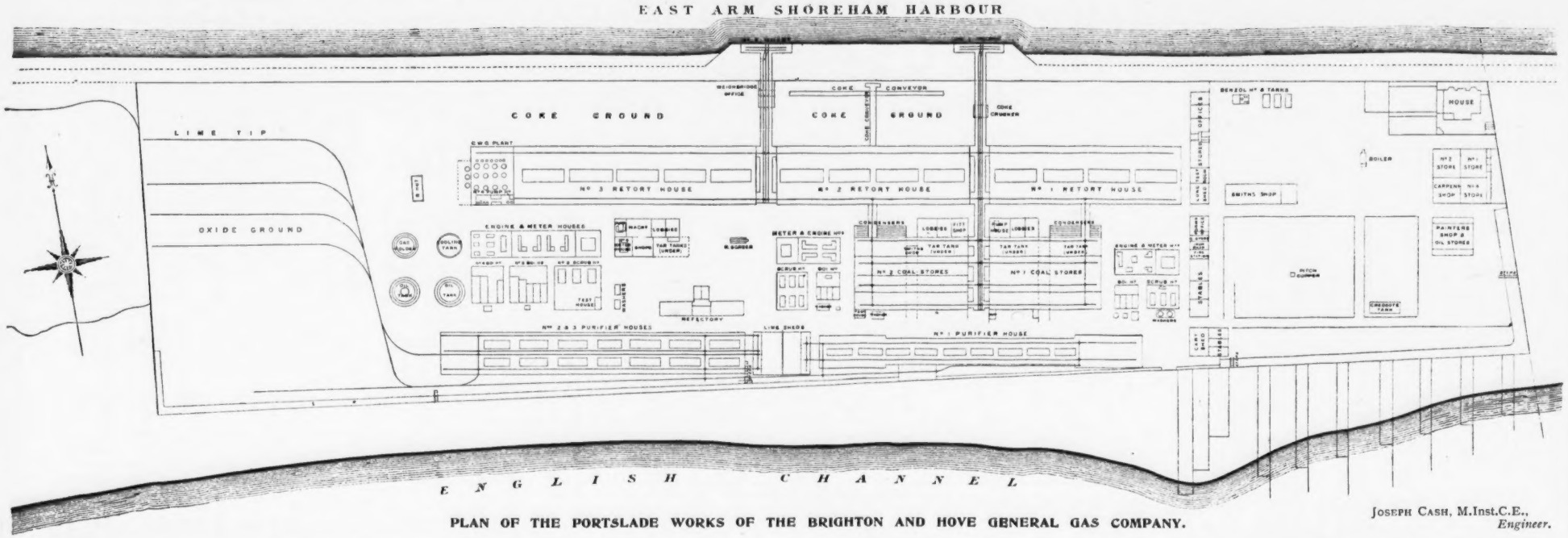
At the Franco-British Exhibition.

On Thursday, as has been stated, the morning sitting was held at the Franco-British Exhibition; and, in the afternoon, the members had an engagement with the Chairman (Mr. H. E. Jones), Hon. Secretary (Mr. James W. Helps), and the Committee of the Gas Section of the Exhibition, for an inspection of their exhibits, and of the manufacturing firms who have associated with the Committee, by exhibiting in the vicinity of the furnished suite of rooms. Unfortunately Mr. Jones could not be present; but the Deputy-Chairman of the Committee (Mr. D. Milne Watson, the General Manager of the Gaslight and Coke Company) assisted Mr. Helps in receiving the large numbers of the members who made an inspection. The whole exhibit, with the exception of one apartment of the industrial section, is now complete. With regard to the suite of rooms, there was a common note of approval at the attractive display the Committee have made; and there was general agreement that the scheme was well conceived, and in its execution was really superb. If there was one criticism, it was that, in certain of the rooms, there are too many fittings on the walls. But the presence of the fittings does not necessitate that the whole shall be used. The chaste and tasteful style in which the rooms are equipped was greatly admired; and the working of the laundry and the activity in the kitchen caused the biggest crowds to collect. Of course, great expense has been incurred; and Mr. Helps still asks for contributions from those who have not assisted in this special effort to demonstrate to the thousands of people who daily visit the exhibition, something as to the vast range of the utilities of gas. The demonstration wants advertising now; and it cannot be properly advertised without more money. There is another point. The numbers of gas engineers and managers who visited the section on this occasion will go away with the idea that there is something better that can, in these competitive days, be done to advertise the advantages and power of gas than the old-fashioned type of exhibition.

The industrial side of the display was also well examined. The Keith compressing plant attracted much notice, the mantle makers went about their operations with an ever-changing but interested crowd before them, as though they were working in the privacy of a factory; the tinworkers proceeded with the making of parts of meters as though in the workshop itself. The shop window, well-stocked with bye-products of gas manufacture (sent by the Gaslight and Coke Company) was studied by those who knew more about them than the lay visitor. There are beautiful examples of chemical product to be seen there, all attesting the wonderful fertility of the residuals of gas manufacture.

The exhibits of the manufacturers who have associated themselves with the Gas Section Committee were inspected with considerable interest. Two or three of the stands that have not been described before are dealt with elsewhere in this issue.

Afterwards, as much more of the exhibition as possible was explored by the members and their friends; and not a few were seen indulging in tests of the lighter novelties of the great show—such as the flip-flap and the scenic railway—enjoying the while the music by the military bands. Those who were not of the party in the evening visiting Berlin, stayed to witness the lighting of the grounds and of the Gas Section. With regard to the high-pressure incandescent lighting in the grounds, it is considered excellent; but much of the effect of the lamps is lost, many agree, by the fact that the columns are too low. The fault is on the heads of the exhibition authorities. The defect has been pointed out to them; but they are not prepared to spend money on improvement. They are contented; and there for them the matter ends. After all, the peak of interest is that these lamps of 1500-candle power only consume 25 cubic feet of gas an hour. Who, we have asked before and we ask again, is there to tell the public this, unless it be through the medium of advertisement, for which the Gas Section Committee require more money?



PLAN OF THE PORTSLADE WORKS OF THE BRIGHTON AND HOVE GENERAL GAS COMPANY.

JOSEPH CASH, M.Inst.C.E., *Engineer.*

Off to Berlin.

The party (numbering about eighty) who had accepted the invitation of the German Association to Berlin, and the hospitality of their colleagues and the Imperial Continental Gas Association and the Municipal Gas Department of Berlin—left Liverpool Street Station at 8.30 on Thursday evening, accompanied by the President (Mr. W. Doig Gibb), the President-Elect (Mr. Thomas Glover), the Vice-Presidents (Mr. James W. Helps and Mr. Alex. Wilson), and the Hon. Secretary (Mr. S. Y. Shoubridge). Our correspondent in Berlin (whose account of the visit will appear next week), writing on Sunday says that the unanimous feeling of the visiting members is that everything so far had been an immense success. The journey across was altogether an agreeable one, excepting that on Friday afternoon the travellers found the heat in the train a little uncomfortable. On Saturday there was a drop in temperature; and the visit to Oberspree and Mariendorf took place under the best conditions. The hospitality of the Imperial Continental Gas Association and of the German Association was, as usual, hearty and complete; the dinner, by invitation of the latter, at Wannsee being a great success. The inspection of the public high-pressure lighting in Berlin that had been arranged had, however, to be hurriedly made, as it was after midnight, instead of 10 p.m., when the visitors arrived back in the city from Wannsee.

Visit to Brighton.

Some of the members made private arrangements for spending Friday; but no less than seventy or eighty left Victoria Station at 10 o'clock for a day at Brighton. The party were in the capable hands of the Secretary (Mr. Walter T. Dunn). The day was an exquisite one for such an excursion. On arriving at Brighton, there was rather more than an hour to spare before luncheon was to be served in the gorgeously decorated banqueting-hall of the Pavilion. The intervening time was spent along the sea front, on the piers, and in the beautiful grounds of the Pavilion. Though lunch was arranged for the early hour of 12.30, after the journey from London the party were quite prepared for the excellent meal set before them. The absence of the President and Vice-Presidents under circumstances that they could not very well control, except at great personal sacrifice, necessitated a substitute for presiding at the luncheon. A worthy one was found in Mr. J. H. Brearley, a member of the Council; and although Mr. Gibb could not be present, he was well represented by his wife, and Mr. and Mrs. J. S. Gibb. This fact was mentioned by the Chairman; and the members present expressed their great satisfaction. Then there were a few toasts. Loyalty to the King and Royal Family was attested with the utmost heartiness. Mr. Herbert Lees gave "The Ladies," associating with the toast the President's wife and mother. For them one of the President's brothers responded. Mr. Brearley acknowledged the kindness of the Brighton and Hove Gas Company in throwing open the Portslade Gas-Works to the inspection of the members, and expressed regret that Mr. Joseph Cash, the Engineer and General Manager of the Company, was unable to be present through a business engagement. He heartily proposed "Success to the Brighton and Hove Gas Company." Called upon by the Chairman, Mr. C. F. Botley, as a neighbour on the south coast of Mr. Cash, responded on his behalf. The "Health of Mr. Brearley" was duly

A VIEW OF THE PORTSLADE WORKS FROM THE MAIN LAND.

pledged; and the opportunity was taken of thanking him for presiding.

In the afternoon a party of the members visited the Portslade Gas-Works; while those who were completely on holiday bent, with the ladies, had a delightful drive along the London Road through Preston Park to Withdean, returning by the circular road to Dyke Road, thence along the sea front to Hove, and, after a short rest for the horses, back by the front to the Pavilion. Tea was served there; and shortly afterwards return was made to London, where the party (all pleased with their outing) arrived about seven o'clock—an hour that enabled them to have a final evening in town prior to their departure for home.

THE VISIT TO THE BRIGHTON GAS-WORKS.

It was greatly regretted by the members, who, in the afternoon, visited the Portslade Gas-Works of the Brighton and Hove Gas Company that the official duties of Mr. Joseph Cash, the Engineer and General Manager, necessitated his presence in London. But it could not be helped; and Mr. Cash knew that in the Assistant Engineer (Mr. C. H. Rutter), who is in charge of these large works at Portslade, he would have an efficient representative. Courtesy, kindness, and interest were blended in Mr. Rutter's reception to the visiting members; and his name brought to the minds of some that it was one that, in times long past, ranked in high esteem among the contemporaries of Mr. J. O. N. Rutter (grandfather of Mr. C. H. Rutter), who was then officially connected with the Brighton Company.

To turn from the personal to the plant that the visitors went specially to see. The works are particularly interesting, in that the coal-gas plant is divided into three sections, and between the life of each section there is a difference of a decade. The No. 1 section was built in 1870, the No. 2 in 1880, and the No. 3 in 1890, and with the early scheme of these works the name of Mr. J. Birch Paddon (Mr. Cash's predecessor) is honourably and indissolubly connected. The three plants, therefore, represent the gas manufacturing experience of three decades. Between the sections there is complete interchangeability—for example, the gas from No. 2 carbonizing plant can be dealt with, in the succeeding processes of purification, by the No. 1 plant, and so forth. The fourth section of the works is a carburetted water-gas plant, which was built, as sets were required, between 1895 and 1900. From 1900, there have been no actual extensions of the main parts of the plant, except the addition of such things as new engines, and the application of stoking machinery to Nos. 2 and 3 retort-houses—hand stoking having prevailed before 1900.

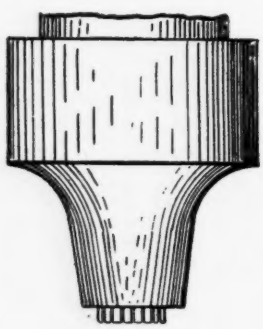
In generally describing the plant, we may start at the reception of the coal; and the description will be facilitated by the plan with which Mr. Cash has kindly provided us. The coal is brought by ships to the east arm of Shoreham Harbour, and is there discharged by steam-cranes on either of the Company's two wharves. The coal is elevated in half-ton loads, and is dropped into hand trucks, with bottom doors, running on rails on the overhead gantry which, at a height of about 16 feet, crosses the public way at the side of the water, then over the works' coke ground and between the retort-houses; and, in the case of No. 1 wharf and gantry, the lines extend between the two extensive coal-stores lying beyond the retort-houses. From these substantially constructed gantries, two lines of rails run (from small turntables on the gantries) through the retort-houses over continuous side coal bunkers, and from No. 1 gantry, other lines also run through the coal-stores. The two coal-stores have sufficient capacity for the whole of the three coal-gas sections—the normal capacity of the two combined being 16,000 tons. As a matter of fact, much more than this can be deposited in the stores if it is trimmed back. When coal has to be removed from store, it is picked up in 6 cwt. lots in tubs, tipped into the hand waggons, and run on the overhead rails over the continuous bunkers at the sides of the retort-houses, being dropped where needed. Over these bunkers,

there is a continuous grating. Most of the coal drops through this; but such little as remains is broken by hammer on the grating. There is one thing that is positively certain to an engineer examining this coal plant from the wharf to the charging-machine—that the cost of repairs and maintenance of the coal plant must be light indeed.

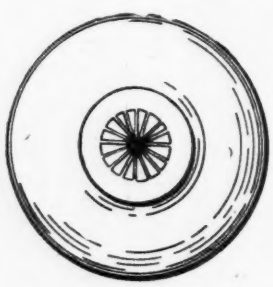
Turning into the retort-houses, it is found that in No. 1 there are four benches of six beds of eight through retorts, or 384 mouthpieces. In No. 2 house, there are the same number of retorts; and in No. 3 there is an additional bench, and the carburetted water-gas plant. The retorts are all 16-inch rounds; and the settings are direct-fired. The Company are well satisfied with their working results, which are really remarkable. Normally, the charges employed are 2¼ cwt.; and the duration of carbonizing, 6 hours. Durham coal is used; and the average production of gas per ton last year was 11,850 cubic feet of about 14-candle power, the remaining 1½ candles, to bring the gas up the standard of 15½ candles, being supplied by the carburetted water gas. The fuel account for the retort-house is between 16 and 17 per cent. Looking at these figures, the equanimity of Mr. Cash over his carbonizing system in face of all that is named progress—sometimes printed with a big "P"—can be well understood. No. 1 house was not actually working; but, if required, would be still hand-worked. Nos. 2 and 3 houses are both equipped with Arrol-Foulis hydraulic machines, with which no difficulty at all is experienced. The charging-machines carry their own coal-elevators, which pick up coal at any part in the length of the retort-houses at the bottom of the coal-bunkers, and lift it to the machine hoppers.

In No. 2 house, coke-conveyors (of the New Conveyor Company's pattern) are employed. These take the coke from the right and left benches to the middle of the house, and away to the coke ground. In No. 3 house hand coke-waggons are used. When labour attached to the coke-waggons is considered on the one hand, and when the cost of repairs to the conveyors is taken into account on the other, the relative working expenditure of the two systems come out at Brighton about the same.

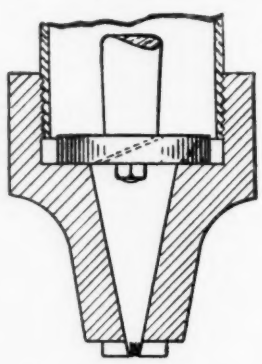
There is no need to go in detail over the whole of the subsequent plant; but, so far as the exhausters, engines, boilers, condensers, washers, and washer-scrubbers are concerned, as has already been mentioned, each manufacturing section has its own complete equipment. Atmospheric condensers are the fashion here. The engine-houses are particularly interesting. There is no storage at this station; and the gas has to be pumped after being purified to the holders at the Hove and Blackrock stations. The engines required for this purpose, the hydraulic power plant, and the exhausters all go to make the engine-houses specially attractive to the mechanical engineer. The whole plant is in duplicate. Washers of Livesey type are used; and then we come to the rotary washer-scrubbers. In connection with these, the Portslade works possess historical interest. In No. 1 section are seen the original washer-scrubbers as designed by Mr. J. Birch Paddon. They were, in fact, the first ever made, and put into practical work; they are in good condition now, and still capable of useful service. One of these old washer-scrubbers (which were invented prior to 1870) was open for inspection; being in process of having the brushes and plates cleaned. Part had been left dirty to show how effectually the machines still perform their work, and part was in its cleaned state to indicate how simple is the construction and how well the



Elevation.



Plan looking up.



Section.

parts wear. The sections (formed of perforated circular steel plates, with brushes between, round the periphery of the plates) only make about fifty revolutions per hour; so that they require very little driving power. Mr. Rutter explained that, in the later types of these washer-scrubbers, there are in each of them 32 plates, carried on central shafts. The entire area of the plates is perforated with ¼-inch holes, four to the square inch. As, therefore, the plates revolve in the water, a bubble forms at each hole, and the gas, passing through, drops its ammonia with the water; and so effectually that at the final scrubber, if so desired, the gas could be rendered absolutely free from ammonia.

It is interesting to look into what was originally No. 1 engine-house, and see the old machinery that was brought from the Hove works. It is old in years, but still good in operation. Here we have an old beam-engine that was built in 1865, and brought down to Portslade in 1870; and it still runs when required. Some old reciprocating exhausters are also seen; and they still work, and work well, when needed. Of course, in all the other sections, the engine plant is of more modern type; but this machinery, in point of preservation and smooth and fairly economical working, shows that the mechanical ingenuity of the past was not in these lines far behind that of the present. While they can without inconvenience do so, we hope the asylum that the Brighton Company have provided for this plant at Portslade will be continued, as there is great interest in it for the gas engineer whose experience does not go back forty to fifty years ago.

Here at Portslade, too, there is a purifier-house with open sides which ranks as one of the largest in the kingdom. It contains the purifiers for Nos. 2 and 3 sections; eight boxes for the former, and six for the latter. There are therefore fourteen boxes in all in the one house, and each are 50 ft. by 20 ft., being arranged in double line. The boxes are all of the water-lute description, are fitted with three tiers of shelves, and only oxide of iron is employed.

Passing on, it is found that No. 3 and 4 engine-houses can be used as desired for dealing with the water-gas plant. In No. 4 house are the Sturtevant fans for the carburetted water gas plant; and the compressor-engine for the hydraulic power to all parts of the works. The water-gas plant, being of the Humphreys and Glasgow type, does not call for any special attention; its features are so well known.

In connection with this plant, we were shown what is called the Brighton nozzle for oil-spraying; and Mr. Rutter had had one of the ordinary nozzles fitted up and two of the new form—one for a small, and one for a large, carburettor—so that a demonstration could be made to show the relative effects. The new nozzle gave a spray so fine that it was almost in the form of mist, and when in use will spray the oil into the carburettor in nearly a vaporous state.

An inspection was also made of the station meters, the works' fittings shops, and a rotary screen, with various degrees of fineness, for sifting ashes. The pan ashes are sold; and the breeze is used under the boilers—the clinkers being disposed of as best suits the Company's purpose. The range of stables was looked into; the works' provision for their private fire brigade was admired; the carpenters', plumbers', and other shops called for notice, as well as the laboratory and stores.

With regard to gas storage, as has been intimated, the holders are situated at Hove and Blackrock; and they have a combined capacity of between 4 and 5 million cubic feet. The annual output is, in round figures, somewhat above 1200 million cubic feet a year. The Company's record day's output was on one day in January of last year, when 6 million cubic feet of gas were sent out in the twenty-four hours.

PAPERS READ.

CO-PARTNERSHIP.

By GEORGE LIVESEY.

The work of the engineer is to apply and adapt the forces of Nature to the use of man. The greatest natural force, however, is the intellect of man himself, which has harnessed Niagara and made the lightning do its bidding. Therefore in all work the chief object should be to secure the intelligent and willing co-operation of all the workers. The development of the joint-stock system necessitates in industrial life the united efforts of many workers. They have intellects, which they will use unless they are so far suppressed and depressed as to become, in Longfellow's words, "like dumb driven cattle." This, however, they will not be now, whatever may have been the case in other times and circumstances. Education has developed intellect; and men will use it for or against their employers. Unhappily, and most unfortunately, it is now generally more or less used against them. I do not hesitate to say that nothing that can engage the attention of business men can compare in importance with the relationship of Capital and Labour. What is

The Existing Position.

Look around; read the newspapers! In all the great trades—shipbuilding, engineering, coal mining, railways, cotton, printing, and many other trades, some connected with our industry—Capital and Labour are at war or upon its verge; and where there is apparent peace, it is too often but an armed peace, with a total absence of the mutual confidence and goodwill characteristic of true and permanent peace. There is a proverb that "the way to maintain peace is to be prepared for war" in national affairs; and the same has been recommended and acted upon in the industrial world. "Strong organizations on both sides" has been the cry; and both employers and employed have adopted it as a system of action. But it has not, and never will—for in the nature of things it cannot—unite Capital and Labour. On the contrary, it creates and accentuates division. And Conciliation Boards and Arbitration Courts, being based on the assumption of divided and opposing interests, are at the best only palliatives. They will never identify the two interests and create a true union.

The late President of the Board of Trade, two or three months ago, expressed the wish that conciliation boards should be formed for all trades. So far his work in that direction in connection with the railways is not promising. The Secretary of the Railway Trade Union prophesied "that most, if not all, the members of the conciliation boards to be elected by the men would be members of the Union;" and lately I read in "The Engineer" that six railway companies had had their elections and had elected 227 Unionists and only 15 non-Unionists, although the non-Unionist workmen vastly outnumber the Unionists. "The Engineer" said: "The elections were turning out much as they expected and much to be deplored." The result may be safely prophesied; but we shall see. At any rate, let *us* keep *our* industry free. Unfortunately, these attempts in the wrong direction are serious obstacles to an advance in the right way. Happily, the gas industry is at present free from industrial trouble and also from outside interference. Long may it remain free to work out its own salvation.

The Position in the Gas Industry.

If inquiry were made, the general answer would be "We are on very good terms with our men," or "We are getting on very well with them; they seem well disposed; and there are no indications of coming trouble." More of the same kind may be said quite sincerely. But on what foundation do the statements rest? In the early part of 1889, I should have said the same; yet in that year the explosion came, and revealed the fact that between employers and employed there was no bond of union. The retort-house men, almost to a man, mainly old servants, and many near the pension age, at the bidding of the Union, parted from the Company never to return. It is true that in consequence of the action of the Union in 1889 the various means and methods adopted for securing independence from labour by greatly reducing the number of men employed, have placed gas undertakings in a strong position in their retort-houses—the point of danger. But mutual confidence and unity of interest are at least as far off as ever. The fact that so much thought and effort and money are devoted to labour saving, until it has become a craze, is proof that behind the apparent outward peace there is a deep-seated feeling of unrest and fear. Hence the extensive adoption of

Machinery and Methods of Working,

in many cases more costly than labour, for the sole purpose of saving labour. This is bad; but the Gas Workers' Union must bear the blame. The expenses of manufacture are increased, men are thrown out of employment whom the community have to keep, and those who cannot find other work are in great danger of drifting into the ranks of the unemployable and pauperism. Apropos of machinery, I quote from the "Daily Mail" a paragraph that appeared while writing this paper headed

When Machinery Can Speak.

Some day man will give his last modicum of brains to machinery and endow it with the power of speech. It will commence by calling him a fool.—"Gazeta," Warsaw.

Man makes machinery to do work which displaces his labour, and he himself starves. There must be something wrong; but do not misunderstand me. I delight in machinery, and to see it in its proper place always is a great pleasure only exceeded by actually using it, though I cannot but feel that when it displaces labour, with no economical advantage, it is not in the right place. I admit, however, that the trouble and anxiety of working and maintaining and repairing machinery are vastly less than in dealing with and managing men under present ordinary circumstances. I confess that if I had to choose between them, machinery would certainly be my choice; but with the relations of employers and employed as they ought to be, and as they are under Co-Partnership, my choice is emphatically for labour in all cases where there are not other good and sufficient reasons for machinery. I must, however, say that the gas industry, whose treatment of its workmen compared favourably with other industries, and which in 1889 was so virulently attacked by the Socialist Gas Workers' Union, had no option but to adopt machinery to displace labour in the retort-houses. Since 1860, machinery had at various times been proposed and tried, but had never succeeded, because the relations with Labour were satisfactory, and there was no motive to take the trouble to make machinery a success. The Gas Workers' Union increased the cost of retort-house labour between 30 and 40 per cent., and at the same time deprived us of all control in the retort-houses. The industry rightly met the attack, and defeated it, by making machinery successful, and thereby recovered its rightful control. The object of the Union was the employment of many more men. They succeeded for a short time; but the ultimate result of their work has been the reduction of retort-house labour by at least 50 per cent. However, the reduction of employment is not at all satisfactory, and a great amelioration of the position is an urgent necessity. Happily, it is found in Co-Partnership.

Why Do We not Act?

The present relations of Capital and Labour in gas-works are no doubt at least as good as those in most other, and vastly better than in many of the largest and most important industries. There is little fear of serious trouble. It is therefore perfectly natural that men should say, "Leave well alone." It is recorded of Lord Melbourne, Queen Victoria's first Prime Minister, that when asked to act he would reply, "Cannot we leave it alone?" This is a perfectly proper and a wise and pertinent question; and if the real and true answer is, "It is well," there is nothing further to be said or done. But I put the question: "Is it really well?" Not only now, but also in the outlook for the future. Does any man who knows the facts regard the present relations of Capital and Labour as satisfactory? Does any such man believe that they can remain as at present? We should look to the future, exercising foresight and imagination.

It has often been said of the English people that so long as they can get along fairly comfortably they are content to leave the future to take care of itself, consoling themselves with the thought that when the time of trial comes they will "muddle through somehow." The Prince of Wales, on returning from his tour round the world, said: "Wake up, England!" in reference to industrial and other matters; and we may well take the advice to heart. One reason why

action is not taken is because on many boards of directors there are men, well meaning, no doubt, but either old, or with little knowledge or experience of labour questions, probably disliking all changes, and therefore very difficult to move. Even a single director of this kind often prevents the introduction of Co-Partnership. A letter just to hand tells me that the most influential director of a gas company "had the greatest difficulty in persuading his co-directors to fall in with his views," and adopt Co-Partnership. This letter was from a relative of the director, and not from any official of the company, and is mentioned as an illustration. Or it may be the engineer or manager who does not see the necessity for action, or perhaps more likely is not satisfied with the present relationship of employers and employed, but does not see how it can be improved. In reply, I would say that if they knew the great help it is to all the responsible officers, the comfort and peace that result, and the peace of mind that it brings to engineers and managers, they would hesitate no longer. Although it is

A Very Great Satisfaction

to work an important business successfully, it is not for a moment to be compared with the satisfaction obtainable from efforts to improve the status of our workmen, to give them hope for their future, to help them to help themselves, to strengthen their character and thereby to make them more efficient as workmen and better servants of their employers, and to place the relationship of Capital and Labour on a sure and satisfactory foundation that nothing can shake. In Co-Partnership this foundation has been found. It is the fulfilment of Mazzini's prophecy of 1858—that the labourer, who was originally a slave, then a serf, now a hireling, must ultimately become a partner.

Partnership

is the only sure and certain settlement of the Capital and Labour question. There is nothing else. Why do I speak so confidently? I admit that my nineteen years' practical experience of Co-Partnership, although it is a large part of a man's life, is a very small period in the development of a great principle. It may therefore be said that this confident statement is premature. Much, however, may be proved in nineteen years; and when I say that from the first and all through there has been striking and constant improvement in the relationship of employers and employed; that the interest of the employed in the Company becomes year by year, as their holding of stock increases, perceptibly better; that during the whole time there has been nothing whatever in the nature of a set-back or a check; that on the extremely rare occasions when an individual here and there thinks he has a grievance there has never been any difficulty in settling it satisfactorily—I feel justified in saying the principle is right, and that in Co-Partnership is found the fulfilment of Mazzini's prophecy, and that the prophet was right when he said the labourer must ultimately become a partner.

Is Proof Wanted that Co-Partnership Pays?

It is not my intention to prove by figures that Co-Partnership pays. This was done in November last, at the meeting of the Southern District Association, when proof was given that, under similar conditions and methods of working, and at the same wages, the cost of retort-house labour per ton of coal was considerably less under Co-Partnership than in its absence; the saving being appreciably in excess of the amount of bonus paid. From the pecuniary point of view, I think it fair that the employer should benefit equally with the employed from Co-Partnership. In fact, the benefits must be mutual or it is not Co-Partnership. In regard to labour generally, fitters, yard labourers, lamplighters, slot-meter collectors, &c., &c., it is very difficult to prove by figures that Co-Partnership is economically advantageous. But it is quite unnecessary. It goes without saying, and is as obvious as a problem in Euclid, and as unassailable, that men with an actual interest as shareholders, and in receipt of an annual bonus dependent on successful working, must be more profitable servants than those who have no connection with, or interest in, the company. This applies specially to the district men, where direct supervision is impracticable. One day the head of a great engineering company questioned me about profit-sharing, and where the bonus was to come from. I asked him whether a cheerful, willing, interested worker was not worth 5 per cent. (the bonus we were then giving) more than an ordinary workman. "Five per cent., say 20," was his reply.

The mention of profit-sharing calls for the remark that simple profit-sharing—that is, the payment of an annual bonus in cash—will not be a permanent benefit either to the men or their employer. The effect soon passes off, and simple profit-sharing in most cases is sooner or later given up. It does not promote thrift, but the reverse, and to be a success it must be made the means of enabling the workers to become shareholders, and therefore partners. It is the shareholding that creates and sustains the interest in the business, which increases as the investments increase.

The Joint-Stock Limited Liability System.

This is, as it were, made for Co-Partnership; but hitherto very little use has been made of it in that direction. By the joint-stock system, the opportunity has been provided for the investment of savings which has resulted in great advantage to a large class; but, unfortunately, the working classes are not to any appreciable extent participators. If they were, their position and prospects, and their habits of thought and life, would be very different. They would not be led astray by Socialism; and, having a stake in the country, we should be a more united people. This most desirable consummation can be brought about by the employers, and by them only; and the only way to do it is by Profit-Sharing Co-Partnership. The advantages are so great to employers and employed, and to the nation, that it is well worth all the thought and effort and time and patience and sympathy required to make Co-Partnership a success. In this way only the principle of the joint-stock system, which is partnership, will have its full development to the general advantage.

The partnership, however, must be complete, and must include all the employees who are worthy. And of them all, who can be so worthy as the chief? To my great surprise and regret, in several companies where Co-Partnership has been recently introduced, the only man excluded is the engineer or manager himself. It is true that in these cases he proved his disinterestedness by excluding himself; but what is to be said for the directors in permitting this exclusion? In one case I have heard that this voluntary and unselfish action of the proposer of Co-Partnership greatly helped him to carry it. But surely such action should lead the directors to include him. Against such exclusion I must enter the strongest protest. The strength of Co-Partnership consists in the partnership of all who are worthy; and all, officials and workmen, must be in the same boat, have the same percentage of bonus, and thus only will the feeling of comradeship from top to bottom and from bottom to top be made complete, and all will work together for the common benefit. I say all who are worthy; and this brings me to the question of

Agreements.

These at the start should be offered to every one in regular employment. Afterwards any employees who are indifferent or careless, or take no interest in their work, must be told that unless they improve their agreements will not be renewed. The renewal in these cases should be for short periods—say, three months at a time—and not for the usual twelve months. If indifferent men have their agreements renewed as a matter of course, the effect on the good men will be very detrimental; and the good that Co-Partnership produces will be undone. The agreements must be in the control of the chief. No subordinate officer or foreman should have the power to refuse in any case, or to grant them in doubtful cases, and they should expire at various times spread over the whole year—which can easily be arranged in a year or two—thus ensuring that no considerable number of men should leave at one time. Agreements or "contracts of service" are the security Parliament has put into the hands of gas and water companies for the protection of the public against strikers; but this provision of the Conspiracy and Protection of Property Act has been far too generally neglected. On the careful and just working of the agreements the success of Co-Partnership largely depends. They are the means whereby the absolutely essential discrimination between the good and the indifferent worker can best be exercised; and thus used they have a valuable educative effect.

The method of introducing and working Co-Partnership was fully dealt with in the paper read at the Southern

District Association last year. The report has been printed in pamphlet form, and with any other information can be had on application to the Secretary of the South Metropolitan Company, and other Co-Partnership Companies.*

Conclusion.

I appeal to Directors for their sympathy and help, and mention for their consideration certain reasons for the adoption of Co-Partnership.

1.—Co-Partnership identifies and unites the interests of employers and employed, and leads them to work together for the common good as nothing else has done or can do.

2.—It relieves the Directors and the responsible officers of all anxiety in their relations with those under them, makes strikes impossible, and enables all questions between employers and employed to be settled amicably and justly, thereby preventing all difficulties and disputes.

3.—It gives to the employed of all ranks a sense of responsibility and an interest in their work unknown under any other system.

4.—By helping them to become owners of property, it makes their present position in life more secure, and gives them hope for the future, enabling them to make provision for old age or misfortune.

5.—The unrest of the present time is largely due to the unequal distribution of property. Co-Partnership effects a better distribution, and converts the "have nots" into the "haves;" thereby displacing discontent by contentment. Co-Partnership is thus the best antidote to Socialism.

6.—By giving men an interest in their work and in the prosperity of the business, and thereby creating a feeling of responsibility for its success, by encouraging thrift, habits of self-denial and self-control are formed, and self-respect is increased and character strengthened. The result must be better workmen and more profitable servants. The Archbishop of Canterbury said the other day that nothing of the human sort tended more to the formation of character than thrift.

7.—Co-Partnership is therefore good, sound, and profitable business.

8.—It fulfils Mazzini's prophesy, and proves it true that partnership must be the ultimate position of the labourer.

9.—The dispute between Capital and Labour has to be settled; Co-Partnership is the final and only solution.

10.—There are great difficulties in many trades in the way of its introduction, but none in gas companies. Is it not therefore the duty of gas companies to lead the way in the great work of showing the way to peace to the world of industry, and thereby benefiting not only themselves, but the nation at large?

For these reasons, I earnestly appeal to gas directors to take up the work, which will bring an abundant reward, and I may add that the more complete the partnership the better. Partnership in responsibility is more important than sharing in profits. Nothing is more satisfactory in the South Metropolitan and the South Suburban Co-Partnership than the top stone—the Employee-Directors. It has given unalloyed satisfaction to Directors, officials, and workmen.

A word of advice. In starting Co-Partnership, it is necessary to gain the confidence of the employees. To gain their trust they must be trusted, and it must be made perfectly clear that it is not simply a selfish move to benefit the company only, for if that is its sole object it will deservedly fail. There are two objects of equal importance to be attained: First, to give the employees an interest in the company beyond their salaries or wages; and, secondly, and quite as important, to enable them to permanently improve their position in life, to help to make them better men and therefore better servants. These objects must be always kept in view. Co-Partnership is comradeship, brotherhood in business. This is the goal which can be won, or I should not waste your time in argument on the subject.

For sixty years have I been at work in the gas industry, and have had the privilege and the happiness of taking part in its advancement and benefit; but looking back over a long and active business life, nothing in connection therewith can compare with the satisfaction resulting from the settlement of the Capital and Labour question by Co-Partnership. It was inconceivable twenty years ago, and would be still but for the fact that it has been done. Its accomplishment is due firstly to being founded on the right principle (the Golden Rule, in fact), and secondly to the whole-hearted co-operation of all concerned—shareholders, directors, officials, and foremen, and, not least, by the great majority of the workmen. A system that creates a bond of union which no other plan has done or can do, must be founded on an unassailable principle.

Our Creator has not left his creature Man without guidance, but has in a single sentence, which is proof of its divine origin, given a rule to govern all the relations and dealings of man with his fellows, in all ages and places, and under all circumstances and conditions. It is often said it is not applicable to business. It is certainly very difficult for imperfect beings such as ourselves to live up to a perfect rule. But it is the fact that the nearer we approach it the better and the happier we are. He who "spake as never man spake" did not make a mistake when He said: "Therefore all things whatsoever ye would that men should do to you, do ye even so to them, for this is the law and the prophets." It sounds almost like sacrilege to quote those divine words in the face of one's own imperfections and shortcomings. But there they are for our guidance in all our acts and dealings; and I venture humbly to submit that their application to the business relations of employers and employed is the system known as Co-Partnership.

Discussion.

Mr. Hubert Pooley (Stafford) said he rose with considerable diffidence to speak on the paper, and only because Sir George Livesey had left out his (Mr. Pooley's) own concern as a profit-sharing gas undertaking. But he wished to thank him most sincerely for his original scheme, which he had studied since its inception. His immediate predecessor in Stafford—Mr. Ferguson Bell, now of Derby—commenced the work in connection with the Corporation scheme in which he was interested, and which he believed was the only one in the kingdom. Sir George had undoubtedly done immense service to gas undertakings in raising the question of profit-sharing—greater service than could be done in the case of a corporation, who could not, of course, make the employees shareholders. A corporation scheme was a very much more difficult one to handle than the company scheme, because they could not interest the employees directly in the capital of the undertaking; and therefore it must become one of those on which the author of the paper had passed certain strictures when he said that the payment of annual bonuses would not be a permanent benefit to either men or employers. With this, however, he could not agree. Their scheme had been in operation now for eight years. In the first two, he agreed, it was not altogether a success. But it was revised in the third year—the whole scheme being based on the labour results; and the outcome had been that the men had divided year by year 3½, 5, 6, 7½ (twice), and in the last year 9 per cent. on their wages. The cost of labour had fallen from 9·2d. to 7·2d. per 1000 cubic feet of gas sold. He should be very glad to give members particulars of the scheme, if they would write him on the subject; but he would not take up time by going into the matter further. He simply gave these results; and again expressed his thanks to Sir George Livesey and his personal indebtedness to him.

Mr. S. Y. Shoubridge (Lower Sydenham), as one who had benefited very greatly from the co-partnership system, and who had had the management of it at the works of the South Suburban Gas Company for the past eleven years, said he should like to state what it had done for the employees there. It was quite unnecessary to say anything in support of the principle of co-partnership, after the very eloquent and cogent argument to which they had listened. The facts were very striking. The system was introduced at his works in 1894; and in the fourteen years since, the sum paid under it amounted to £30,479. Of this, £24,804 had been invested in the Company's stock; and £3514 had been left on deposit, at interest, with the Company—making a total of £28,318; the average per man

* Sir George stated here that the Companies he referred to were the South Metropolitan, Commercial, South Suburban, Chester, and Newport. In addition this year the Leamington, Rugby, Walker and Wallsend, Wrexham, Bournemouth, and (he thought he might add) the Tottenham had adopted the system; and others were coming on. With regard to Bournemouth, Mr. Harold Woodall subsequently stated that the matter had not yet been definitely settled. Respecting Rugby, Sir George remarked that he understood Mr. Meiklejohn had got over the difficulty of how to apply the system to a maximum price Company; but Mr. Meiklejohn later on corrected the mistake. Rugby is a sliding-scale Company; and Mr. Meiklejohn informs us that on the present price of gas 5 per cent. bonus is given to the men, with ½ per cent. variations as the price goes up or down 1d.—that is to say, at 2s. 4d. per 1000 cubic feet, the bonus is 5 per cent., 2s. 3d. 5½ per cent., 2s. 2d. 6 per cent.; 2s. 5d. 4½ per cent., 2s. 6d. 4 per cent., and so on.

being £53. In addition to this, twelve employees had purchased their houses out of the money received as bonus. This was a sufficient proof of the material advantages which the scheme conferred on them, and also of the habit of thrift which it induced. This very large sum had not been paid by increasing the charge for gas or by reducing the dividends, starving the works, or lowering wages. On the contrary, the price of gas had been reduced, while the dividends and the reserve fund had been increased; wages and salaries had been raised; and the works had been greatly improved out of revenue. It might be asked: Where did the money come from? Partly, no doubt, from the improved method of working, but mainly from the hearty co-operation of the employees—all working enthusiastically for the good of the Company. The result of the co-partnership spirit was an improvement in the *morale*, which had been enormous; and he heartily endorsed all the author had said as to the good feeling engendered between employers and employed by this beneficial system. He had yet to learn of any other which could do so much for both parties. He believed it to be the best that could be devised; and, with all his heart, he commended it to the earnest consideration of the members, for it deserved it quite as much as any new system of carbonization, purification, or any other development of the work, and it would give a far higher reward. Of all the great services which had been rendered to the gas industry by the author, none was of equal importance to this. Thousands of tongues at the works of the South Metropolitan and South Suburban Companies blessed him for his efforts for their advancement by means of the co-partnership system; and thousands yet unborn would live to bless his name for the great benefits which would result from it. He (Mr. Shoubridge) most earnestly hoped that the members would give the subject their full consideration, and do their best to induce their directors to adopt it. He was quite certain they would live to look back on the day they did so as the best in their lives.

The PRESIDENT remarked that Sir George Livesey was quite as anxious to hear criticisms or questions regarding the working of the system as listen to speeches in favour of it. They all knew he was a good fighting man, and nothing would please him better than for an opponent, if there was one in the room, to get up and criticize the paper.

Mr. C. STAFFORD ELLERY (Bath) said he did not know that he dare criticize Sir George Livesey, after his many years' service to the industry. At the same time, he did think there was another side to this question; and he wanted, in a few words, to put it, rather for the sake of hearing what Sir George would have to say than for the purpose of airing his own views. First of all, the author made the remark that "this most desirable consummation could be brought about by the employers, and by them only; and the only way to do it was by profit-sharing co-partnership." He (Mr. Ellery) did not suppose there was anyone in the room who did not agree with the author in his desire for the welfare of the working man; he rather objected to the statement that profit-sharing co-partnership was the only way, because he saw serious difficulties when the splendid support of Sir George was removed, when he fancied the difficulties would be more felt than they were to-day. He noticed in the paper a particularly great development of the scheme; it was no longer mere profit-sharing, but co-partnership. It was a considerable advance upon what it was at the beginning. He admitted that the fact of making the position of the men stronger, by giving them a large share in the stock of the company employing them, was something far safer than telling them they should have a share in the profit obtained from reducing the price of gas. But this was where his difficulty arose. He saw so many points at which the workman, or even an officer (though he would prefer to leave the officers out, as it might be rather a personal matter, and speak only of the workmen) had no influence. He would not take the London Companies who had adopted the system, as they were fortunate in the "psychological moment" when they did so—when the price of gas was falling and falling. But taking the case of a Company like his own, with gas at 2s. per 1000 cubic feet, it would not be at all the "psychological moment" for them. The price of material had been gradually rising; and to his mind it was scarcely fair that the workman's wages should begin to fall merely because of this. As far as he could see, the profits of the Company depended largely on the efficiency of the workman, and his willingness to do his duty; and they also depended very largely on circumstances over which the workman had no control. Take the case of machinery. He quite agreed with the remark that machinery was being too largely introduced. It often cost more to handle material by machinery than by hand labour. But his point was this: Taking one works not using machinery, or another using it, the cost of gas must be largely influenced by the amount employed. A man might be working never so willingly; but circumstances over which he had no control would affect the price of gas, and his willingness to work would not. He (Mr. Ellery) did not see why the workman's wages should suffer because of circumstances over which he had no control; and it might also depend on whether the men in one department were as interested as those in another. Then there might be a very conservative manager—there were such people—a man who would not march with the times, and adopt the methods most likely to bring about improved results. Perhaps Sir George would say that if they had a man of this character, not amenable to profit-sharing, they might well deal drastically with him. But it was not always possible. They might not find a Board of Directors who would be willing to do it. There were in gas-works many circumstances over which the workers had no control; and he could not see the fairness of their income being affected by these circumstances, especially at times when the price was going against the undertaking. He had been to some trouble to investigate, during the last ten years, the Gas Companies in London and the neighbourhood who were working under the scheme dealt with in the paper and those who were not; and he really could not see that the Companies who had adopted profit-sharing had brought about such marked results as to be producing and selling gas at a figure more favourable to the consumer than the others. With regard to securing the goodwill of the men, he found they had this; and he was not aware that, in works where there was no profit-sharing scheme, there was any disposition to antagonism on the part of either the management or the men. He did not like the idea to go forth that only those who adopted profit-sharing could boast of goodwill between the workers and those who employed them. He was proud to say that he looked upon the workmen as his friends; and he thought he might safely state that they reciprocated the feeling. He did not think, therefore, it was all on one side. If there was so much confidence, why did Sir George want the agreements to expire at different times—if he was quite sure that he would always find his workmen absolutely reliable? They might depend upon it that there was something more behind all this. More had to come out; and if they could only get it threshed out, he should be very pleased indeed. He felt that if Socialism—the rampant Socialism of those who talked about sharing property—was to be met, it could be done in another way than by this suggestion of giving the men a share of the profits which they could not control. There were such things as benefit societies and thrift societies; and some companies induced their workmen to put their savings in the hands of the company, or, if they liked, to invest them in the stock. It was most admirable, no doubt, to induce men to become shareholders. The only question was whether their profits should depend upon the price of gas, which they could not influence, or whether they should not be settled by a more generous attitude on the part of the Directors towards their employees. He was quite sure the day would come when the workmen would be looked upon as really those who were, to a large extent, producing the profits.

Mr. H. W. WOODALL (Bournemouth) said he must correct one slight error in the paper. They had not yet adopted the co-partnership scheme at Bournemouth. He hoped it would be done shortly; but the Company had not yet definitely decided upon it. The principal reason for his wishing it advanced was the question they had heard so much about—the question of thrift. He did not believe they would ever get working men to be thrifty if it were left entirely to their own initiative. If they gave a man something, he would add to it; but if they did not give him a start, he would never make one for himself.

Mr. T. BERRIDGE (Leamington) said he did not agree at all with what Mr. Ellery had said. He had suggested that they would reduce the workman's pay; but they did not do this in works where there was profit-sharing. They had the same pay as in any other works, and the bonus was in addition. His experience already proved that the men had earned, and almost more than earned, it. They took much more interest in their work, and did it much better. To

ANOTHER "BLAND" SUCCESS.

"The universal reply is, Satisfaction."

Mr. J. D. ASHWORTH, M.I.Mech.E., Engineer and General Manager, Portsmouth Gas Company, writes:—

"We have about 6000 'Bland' Burners fixed in this Town, in use in Factories, Shops, Churches, and Private Houses, and the universal reply is, 'Satisfaction.' The general appearance of the Burner is good, and lends itself to almost any style of decoration."

"We have tested the Burners under various conditions, and find that an exceedingly good light is maintained with a small consumption of Gas, while the maintenance proves itself to be exceptionally low."

J. D. Ashworth

The "BLAND" Burner is particularly suitable for

CHURCH, FACTORY, & DOMESTIC LIGHTING.

Baddow Church, Chelmsford, photographed at night by the "Bland" Light only.

THE BLAND LIGHT SYNDICATE, LTD., Show-Rooms: 63, Queen Victoria St., London, E.C.; 20, Fennel St., Manchester.

THE FRANCO-BRITISH EXHIBITION.

The Gas Exhibit at the Franco-British Exhibition is outlined with the **Bland Burner** (as illustrated below), with great effect, and should be seen after dark.

The only complete Stoker.

REGISTERED
DISCHARGING CHARGER
F.A.
SIMULTANEOUS
TRADE MARK.

THE FIDDES-ALDRIDGE
SIMULTANEOUS DISCHARGING-CHARGER.

The One and Only
Machine which Discharges and Charges at
One Stroke.

No Wear to Retorts. No Waste of Coal. No Cooling required.

Charges not thrown heavily into the Retorts.

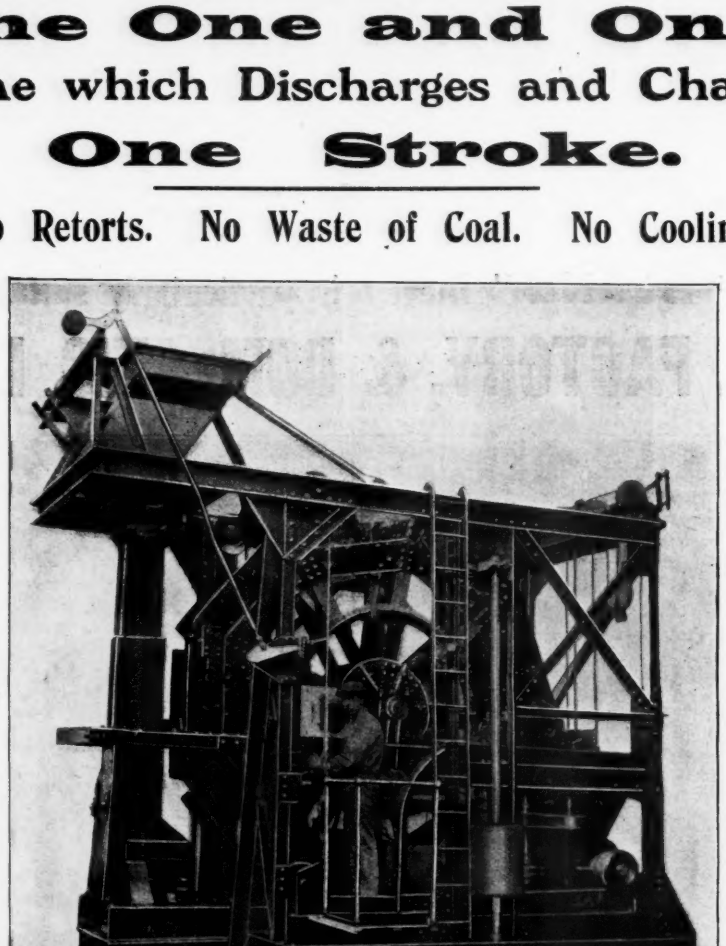
Highest Illuminating Power.

Highest Thermal Value.

Largest Yield per Ton.

Lowest Cost of Carbonizing Attainable.

Machine takes its supply of Coal Automatically from Overhead Hoppers as it Travels.



Installations at Work and on Order—

Liverpool
Bristol
Wrexham
Peterboro'
Coventry
Leicester
Fulham
Strasburg
Rotterdam
Antwerp
Buenos Aires,
&c., &c.

Some of these being Repeat Orders.

This Machine was designed and brought out by the Patentees to supersede the Projector Charger invented, patented, and used by Mr. Wm. Fiddes in 1893, which **PROJECTOR** was **DISCARDED** by him **ON ACCOUNT OF** the packing of the Coal in the Retort, the **DUST, WASTE, FLAME, SMOKE, NOISE,** and General Discomfort to the Workmen resulting from its use.

Telegrams: "MOTORPATHY, LONDON."
Telephone: 5118 WESTMINSTER.

Works Department.
Telegrams: "SIMULTANE, BATH."
Telephone: 1036 BATH.

ALDRIDGE & RANKEN,
9, VICTORIA STREET,
LONDON, S.W.

give an example: A short time ago, a friend of his told him he was in a grocer's shop in the town, not far from the gas-works; and while he was there a canvasser came round from the Electric Light Company, trying to persuade the proprietor of the shop to take the electric light. But his friend heard him say he could not—in fact, that he dare not; that the men at the gas-works had held a meeting, and decided that they would not deal with anyone who had the electric light put on, and that he should be cutting off his living if he adopted it. Yet the men at present had not had a copper, and would not have one until the 1st of July. But they took so keen an interest in the matter that they were not going to deal with people who did not support them. He was quite certain it would pay everyone to adopt co-partnership.

Mr. C. MEIKLEJOHN (Rugby) said he wished to correct a slight misapprehension on the part of Sir George Livesey in regard to his Company. It was a sliding-scale Company, commencing at 5 per cent. on the present price, and reducing with each penny increase in the price of gas. Profit sharing would apply as well to a non sliding-scale company as to one working under a sliding-scale. He must say he had no sympathy at all with Mr. Ellery's remarks. He thought Mr. Berridge disposed of one of them in stating that the wages of the workmen were determined by ordinary rule, and had nothing to do with the question of a bonus, which was a free gift on the part of the Directors to the employees. Mr. Ellery appeared to approve of the idea of working men becoming shareholders; but he was not quite so sure of the bonus rising and falling with the profits. He (Mr. Meiklejohn) thought Mr. Berridge might see the advantage of the bonus being given on the profits. It enabled the men, and compelled them, to become shareholders in the company. This was the essential principle of the co-partnership scheme. With regard to improving the relations between employers and employed, he thought it was an admirable scheme. His Directors adopted it, not because they had ever had a word of complaint from the workmen in the sixteen years during which he had had control, but because they thought it was the right thing, whether or not it affected the cost of carbonization. He believed that if it were adopted by every gas company, it would be a success, because it was a method of dealing honestly with their employees.

Mr. T. HARDIE (Gateshead-on-Tyne) said he quite agreed with Sir George Livesey that the adoption of co-partnership was the best way of meeting Socialism, because it would make every workman a capitalist. He had studied the scheme several times, and endeavoured to think of some way by which it could be adopted at his own works. It seemed to him, however, that the question was how this could be done at the present day, when everything was being cut down practically to the limit, and the only way of increasing the profit was by reducing the number of men employed. Under the scheme of co-partnership and profit-sharing, the workman had to give more than he had been doing; and it was out of this "more" that his employers were to allow him the bonus. Unless he gave them more profit, they could give him no bonus; and this meant a reduction in the number of men to produce a reduction of wages. Was it possible that men, where they were strong Unionists, were going to adopt a scheme in which the number of men employed was to be diminished? At the time it was adopted, in 1889, and immediately after, the increase in the consumption of gas took up the larger output produced by the men. But in the present day, the increase in consumption was only very small; and if the men augmented the output by 5 per cent., they would very probably more than meet the extra demand, and the number of men would then have to be reduced.

Mr. A. COOKE (Oldbury) said they had just heard how co-partnership could be applied to gas companies; but he should like to know how it could be introduced in works owned by a district council. In his own case, they had no Union men, but there was a very good feeling with them; and he should be pleased to know if the co-partnership scheme could be made applicable to such works.

Mr. J. WILKINSON (Halifax), supporting the remarks of the last speaker and Mr. Ellery, said he thought it would be very advantageous if Sir George Livesey could tell them if he had ever thought out any other scheme whereby profit-sharing could be introduced on a basis other than that of the price of gas. He could endorse Mr. Ellery's remark as to the workmen being unquestionably liable to suffer from circumstances over which they had no control. They had all many times seen the statements made by Sir George with regard to unity being strength, and as to combining against what might be termed oppressive measures on behalf of coal owners to control the price of coal, and his proposal that, if they attempted to obtain an unfair price, buyers should try to hold out against them. Now, if gas engineers combined together to secure what they thought was a fair price for coal, surely workers were just as much entitled to combine to ask for and maintain what they thought was a proper wage; and if the gas workers were loyal to the colliers, they would support them in obtaining a higher wage for getting coal. But this would tend against the interest of gas workers, because if the gas companies had to pay more for coal it would mean a higher price for gas, and consequently a lower bonus to the men; so that there was a great deal in the remark of Mr. Ellery, that some other basis of profit-sharing should be considered. No one had given the same amount of attention to this question as Sir George Livesey had done; and it would be of the utmost value if he were good enough to say whether he had ever considered any other basis. He (Mr. Wilkinson) also agreed with Mr. Ellery with regard to the agreements. He did not believe in binding any workman. They must trust him, pay him a fair day's wage, and not hang over his head a sword in the shape of a threat that if he broke his word he would be discharged, and lose the benefit of the bonus scheme. He was then a pressed man and not a volunteer; and it was a well-known maxim that one volunteer was worth ten pressed men.

Mr. CHARLES CARPENTER (London) said he could speak for a few thousand men in the service of the South Metropolitan Gas Company, that they would be highly aggrieved if they were not allowed to sign the agreements. They greatly preferred working under an agreement which ensured their being employed for a certain fixed period, to working according to the ordinary terms, under which their work might cease on a week's notice being given on either side. He did not wish to take up time on a subject which had been so fully discussed; but there was one aspect of it which had not been touched upon, and with regard to which it was only right to say a word—namely, as to there being workmen representatives on the board of the company. He did not think there was any point with regard to the working of co-partnership systems which had been of such great advantage to the company with which he was connected as the part of the scheme that provided for the election by the workmen of representatives to sit on the Board. The workmen who had been so returned by ballot of their members had behaved in every respect as gentlemen should behave. They were honourable in all their dealings, and courteous; and their sole desire had been to help forward the interests of the Company. They looked at affairs not merely from the workmen's point of view—and that was of great educational advantage—but from an all-round point of view as men of affairs. If they could get workmen to so regard things, they would have them occupying a very different position from that which they occupied now. Despite what had been said by Mr. Ellery, who, he thought, was about twenty years behind the times, there was a great change coming over the country. Workmen would not always be content to remain as they had been in the past. They would want to have a share in the prosperity of the country in the same manner as the middle classes had; and he believed that what would result from a wide application of the co-partnership system would be this—that the working classes would cease to remain outside the middle class, and become merged therein. After all, there was not so very much difference between working men like themselves and those working at the bench. The distinction was not an essential one. He believed that the teaching and training of co-partnership would induce working men to lead different lives; and they would cease to come into the works in the morning with the idea of doing as little as possible for their employers. He knew this spirit did operate with a good many men. The South Metropolitan Company several years ago were in the same position as Mr. Ellery was in to-day. They were on extremely good terms with their men; they supported their pension societies and benefit arrangements, lent them money without interest, and did all sorts of things to put them on good terms. But there was not really the bond of sympathy that existed now, which was something inexplicable except by those who had had actual experience of it—something magnetic in character, which could be felt rather than seen or described. He for one would not work under the old

conditions again. He had been under both, and knew the difference; and in whatever position of responsibility he was placed, if he had to come in contact with large numbers of workmen, one of the first requisitions he should make would be that a similar system to the one under consideration should be introduced.

Councillor H. GELDARD (Bradford) said he had listened carefully to what had been said, being Chairman of the Gas Committee of the large gas undertaking belonging to the City Council; but only one of the speakers said anything as to what could be done by a corporation in this matter, because they were somewhat differently placed to a gas company. If they were fortunate enough to make any profit, it went at once to relieve the rates; and he should like to know how they were to introduce such a system as the one dealt with in the paper, especially where all their men seemed perfectly satisfied with their lot, were receiving a fair average amount of wages, and were being constantly employed.

Mr. HERBERT LEES (Hexham) said he understood that Sir George Livesey put forward his scheme as an antidote to Socialism; but so far as he could gather from listening to the paper, Co-Partnership was Socialism—Socialism of the best kind. Mr. Meiklejohn had told them that the arrangement was introduced because it was righteous; and, taking the quotation given at the end of the paper, it seemed to him that the object the writer had in view was that they should cultivate not only friendship with the workmen, but that they should all be partners in the same work, which was the best type of Socialism. The question had been asked how the scheme could be applied to a corporation undertaking. He could well understand that there was a difficulty on the basis of dividends, because none were paid; but this did away at once with the argument of making the workmen owners or part owners. As ratepayers they were all owners of the concern. They did not get the benefit directly; but they had their rates reduced, and in this way had the profits. Obviously, it was not necessary in corporation undertakings to satisfy the workmen by making them part owners of the concern. After all, notwithstanding the criticism levelled against Mr. Ellery, there was a great deal to be said for his point of view. There would be the fear which they would have to contend with on the part of the workmen that this was another way of increasing the wages for the time being, and of reducing them in the future, or preventing a further increase. They would have to meet this contention, which would obviously be made. When once the bonus system was commenced, would the men be able to look forward to the normal increase of wages they had received in the past? They themselves were not satisfied with merely standing still; neither would the workmen be. They would surely expect to improve with the progress of the concern. He took it that this was the intention of the author of the paper. But was it not a difficulty that had to be met? Apart from a bonus scheme or a co-partnership scheme, as the case might be, could they persuade the workmen themselves that they would not suffer somewhat in this regard? This point had been much emphasized by the discussion. Most of the speakers had in their minds the question: Did it pay? They could not get away from this fact. Where was the money to come from? Was it not to come from the extra work which the men did for the additional remuneration they would get? If not, could they persuade their Directors to adopt it? These considerations were not, to his mind, made clear; and he would be glad if Sir George Livesey could throw any light upon them.

Mr. E. A. HARMAN (Huddersfield) said the whole spirit and tenour of the paper under discussion was absolutely charming; but he should like to ask the author if he did not think that the matter could be equally well settled by remunerating the workman better in the way of wages. If they paid a man well, they generally got the best out of him. The co-operative principle which prevailed so largely throughout Yorkshire was in the same direction as co-partnership; and everybody knew that the dividend was the object of interest to purchasers at the stores. Whether the result was always satisfactory was a question. His own opinion was that it was very much better to deal with a tradesman and let the dividend go. He thought the same principle obtained with regard to co-partnership; and he doubted whether they would not get as satisfactory work from the men by paying them good wages—say, by giving them an extra 10 or 20 per cent.—as by making them co-partners.

Sir GEORGE LIVESEY, in reply, after thanking the members for the interesting discussion which had taken place, said he must answer Mr. Harman's question by a most emphatic "No." Giving higher wages would not do it. He could say this most certainly. Gas companies had paid higher wages generally than most other trades in the same district; but it had not produced any general interest on the part of the workmen in the affairs of the Company; it had not induced better work. Besides, had not this been tried long enough? How many thousands of years had the wages system been tried; and where were they now with it? They were in the present position. He had nothing to say in reply to Mr. Shoubridge; and he was very pleased to hear Mr. Ellery put his points. The first question was rather a personal one—when he (the speaker) was removed, what would likely happen? Well, he believed that principles lived when men died; and if co-partnership was the right principle, which he believed it to be, it was not dependent on the life of anyone. In his opinion, it was a thoroughly sound principle—the only one, indeed, which would settle the question of Capital and Labour. He firmly believed Mazzini was right when he remarked that the labourer must ultimately be a partner. Leclaire was the first to put the principle into operation in Paris, about the year 1830. Leclaire was a house painter and decorator; and he gave his men a share in the profits made. The ultimate result was that, at the time of his death, his business had got entirely into the hands of his workpeople; and it was in their hands to this day. Mr. Ellery had brought forward a point which had been raised before—that Bath was selling gas at the very low price of 2s. It was a sliding-scale Company; and so there was not much room for any reduction of price or increase of the bonus. He thought they might start by giving a bonus of 5 per cent., as Mr. Meiklejohn had done, to rise and fall with the price of gas. If they reduced the price, let the bonus increase; if they raised it, let it decrease. It was said that this was not fair to the men. But was it fair to the consumer that he should suffer because coal owners or miners put up the price of coal? It was a singular fact that this question of the consumers suffering was the origin of the sliding-scale. In 1873 and 1874 he saw the effect. When the first coal panic arose, there was a great increase in cost, and gas companies put up their prices sufficiently to enable them to pay full dividends. Then it occurred to him that this was not fair. Why should the consumers bear the whole burden? Would it not be fair that the shareholders should bear a part of it? This was the origin of the sliding-scale; and co-partnership was simply an extension of it. He said emphatically that if any misfortune or disadvantage came to a gas company where this system had been introduced, it was perfectly fair that the consumers, the shareholders, and the employees should all suffer together. They were "all members one of another;" and when one member rejoiced the others should rejoice with him, and when one suffered the others should suffer with him. This was a perfectly fair and right principle; and it was one which worked well. The two Companies with which he was connected had had cause to reduce seriously the co-partnership bonus. In the South Metropolitan Company they lowered it from 5 to 3 per cent. in 1893 or 1894, without a word of remonstrance. In 1900 there was a much more serious reduction. They were paying 9 per cent.; but they raised the price of gas to such an extent that it extinguished the bonus altogether. Still there was not a word of complaint. However, they took advantage of that opportunity in order to revise the scale; and so, in effect, the bonus paid in one year was 9 per cent., and in the next year, under this revision, it was only 3 per cent. But again there was not a word of murmur. Now they had reduced the bonus to the South Metropolitan and South Suburban Companies' men in connection with the increase in the price of gas. In the former case, it was reduced 2¼ per cent.; and there was not a word of complaint from anybody, because they realized that it was fair. It was a most valuable principle to inculcate—that people should bear their burdens jointly. As to dealing drastically with indifferent men, the great advantage of the co-partnership system was that they did not need any drastic action at all. The careless, thriftless man had, to a large extent, been made a good man—thrifty, careful, and interested. It happened in this way: They said to an indifferent workman: "Your agreement will not be renewed unless you improve." When the time for renewing the agreement came round—and the man was always very anxious to have it renewed—he

was told to come again in three months. At the end of this time, perhaps, an agreement was granted him only for three months; and the effect was to put him on his mettle to try to do better, with the result that very few indeed of the indifferent men failed to become vastly improved. Mr. Ellery had raised a laugh—in which he (Sir George) joined quite as heartily as anybody—about the agreements expiring at different times. This was simply the right and the proper thing; in fact, they could not do otherwise. How could Mr. Carpenter deal at once with 5000 or 6000 agreements, all expiring at the end of the year? It was not their own men with whom they had any difficulty. As Mr. Hardie had said, the men were all right if they were not interfered with by agitators. In 1889, it was the agitators. There was nothing amiss among the South Metropolitan men; and he could have said exactly what Mr. Ellery had done. He had given credit for the best of dealing with their men by gas undertakings; but the agitator came in, and upset the men. They said they had no objection if the agreements all expired at a month's notice.

Mr. ELLERY: I thought you said profit-sharing had killed the Union.

Sir GEORGE LIVESEY said it had practically done so. He was perfectly certain they would go on very well without agreements; but the men preferred them. When he was sitting on the Labour Commission, the late Mr. Mundella, who was rather suspicious of him at first, said he liked the system immensely, but did not like the agreements. He (Sir George) replied that they were not an essential part of it; but he said he would put the matter to the men. He called together the Workmen's Committee, which consisted of eighteen men elected by ballot, and told them what Mr. Mundella had said. The men implored him not to touch the agreements, and said it would create no end of disappointment to interfere with them. He took this message to Mr. Mundella, who said he was satisfied. By distributing the agreements over the year, the men were protected; it was not the employers only. When the agreements were first introduced, they were as much appreciated by the men as by the Company, because they wanted protection. They were then able to say they could not strike when they were under an agreement; otherwise they might all be called out at the dictation of the Union—not that there was the slightest danger of it now. Making the agreements expire at different times, the manager could give his personal attention to their renewal; and something must be kept in his hands. As to Mr. Ellery saying there was no advantage to the company, Mr. Shoubridge, Mr. Carpenter, and Mr. Berridge had all pretty well answered that objection, even in Mr. Berridge's case; and with regard to good-will, Mr. Irving reminded him that there was good-will in existence, but that it was not proof against the agitator, who could come and poison the minds of the men. As to the men sharing property they could not control, they enabled them to become property-owners. They had shares in the company, and did control it. In the case of his two Companies, there were two workmen Directors at the South Metropolitan, and one might be a clerk; so that there were three employee Directors against six ordinary Directors, and all the three had the same legal voice and vote as any one of the others. As one of the Directors had said to him, it was heaven on earth. As to the workmen producing profits, the time had come when the socialistic people were saying they produced all the profit—they produced it all and demanded it all. Co-partnership was a checkmate or an antidote to socialization. If they could make every penniless workman an owner of property, he would not be likely to be a Socialist. With regard to Mr. Berridge's little story, he (Sir George) could tell them another. At a meeting held in one of the co-partnership companies' towns, a member of the Council moved that electricity be installed in place of gas for the public lighting. Some of the co-partnership working men, feeling an interest in the matter, went to this man and said: "We understand you propose that gas should be abolished in the streets and electricity introduced." "Yes," he said. "What is that to you?" The man replied: "We work at the gas-works. We buy our tobacco of you, but if you do not drop this, we shall not buy any more tobacco at your shop." And the project was soon dropped. Mr. Hardie had raised a very pertinent question about reducing the number of men; but there were other ways in which co-partnership paid. It would be worth all it cost for the comfort they obtained. As to the workmen accepting it, he could only say, "Try them." In Mr. Berridge's case, they were all new workmen; but when the matter was put to them, they all accepted it gladly. There might be something in what Mr. Hardie had said about reducing the number of men, seeing that business was not increasing; but he still went for this in order to give the men a direct and real interest in their work. In face of this, all other considerations must go. They might depend upon it, if they would create a downright interest in the workman in his work, co-partnership would answer the purpose; and the workman would accept it. As to applying it to corporations, he thought Mr. Pooley had answered this question He (Sir George) was very pleased to hear what he said, and regretted he had not mentioned Stafford. Of course, a corporation could not be a co-partnership, except in a very vague and indefinite way; and he did not think the employees in the gas-works would be very much affected as partners. But Mr. Pooley had explained how he did it, so far as his Corporation were concerned; and he (the speaker) thought this was an answer to Mr. Cooke, as well as to the gentleman who spoke for the Bradford Corporation (Mr. Geldard). This was one argument against corporation gas-works, that they could not unite Capital and Labour—they could not create union; there could be no real partnership between them. Mr. Wilkinson asked whether there was any other scheme which could answer the purpose. He could only say he did not think there was any other than the partnership basis, making the men shareholders. Mr. Lees rather amused him by calling him a Socialist. He had always prided himself on being at the antipodes of Socialism. But he was with them in this, that they said they wanted a better distribution of property; and he emphatically agreed that a better distribution was wanted. But there was a right way and a wrong way of doing it; and he contended that co-partnership was the right way, whereas socialization would be the wrong way, as it would bring ruin to everything. As to wages, they must be tied by the law of supply and demand. But they gave a bonus, whatever it was, in addition to wages. The two co-partnership Companies with which he was connected were the first to raise stokers' wages in London in 1898. There was a difficulty in getting stokers, because they left early in the year for other work. The law of supply and demand showed that they were not paying enough. So they increased the wages from 5s. 4d. to 6s. a day; and then they got them. The two co-partnership Companies did this first, and all the others followed. He would conclude by thanking the members for their patience, and by assuring them that by the adoption of the co-partnership system they would do something for themselves, for their companies, for their shareholders, for their workmen, and for the nation; and it would be better work than any other they could do in connection with the business.

RECENT EXPERIENCE WITH THE DESSAU VERTICAL RETORTS.

By A. F. P. HAYMAN, of Berlin.

At the kind suggestion of the Council, Mr. Ernest Körting was asked to give an account of recent experience with the Dessau vertical furnace. To his regret, he has found it impossible to be present in England owing to the fact that the meeting of the German Association of Gas and Water Engineers, in which he occupies an important position, is taking place in Berlin at the same time. He, however, sends to his English colleagues his very hearty greetings, and hopes to welcome them at the close of their meeting, and to show them what is being done with verticals in Berlin.

Much has already been published as to the progress of the Dessau vertical system in Germany; but as the matter of carbonization in vertical retorts is now occupying the minds of most gas engineers, Mr. Körting, who has done much to elucidate the many problems connected therewith, was of opinion that it might prove of interest to members of the Institution to hear how the results achieved hitherto have been maintained; and he has deputed the writer to give some facts as to the progress the system is making in Germany and elsewhere. The writer would ask the indulgence of the members if he very inadequately acts as the representative of Mr. Körting on the present occasion.

This system has made much progress in Germany, and now holds the field against all comers. Fourteen German towns have erected installations with altogether 888 retorts,

the most important being: Cologne, 24 furnaces with 240 retorts; Dortmund, 10 furnaces with 100 retorts; and Berlin (Mariendorf and Oberspree), 11 furnaces with 132 retorts. Outside Germany there are Zürich, 10 furnaces with 100 retorts; and Barcelona, 15 furnaces with 150 retorts. As these retorts are practically all kept in action, and the old systems only remain as a reserve, it means that on the Continent the Dessau vertical retorts are now producing gas at the rate of 5000 million cubic feet per annum. Further, eleven towns have installations in course of construction with a total of 1132 retorts. The Berlin Municipality alone is about to erect 32 furnaces, as the result of a satisfactory trial with one furnace at their new Tegel works. The Directors of the Imperial Continental Gas Association, with their customary desire to adopt the very best plant which is to be had, compatible with efficiency and economy, have decided on erecting verticals on a large scale in Berlin. A new retort-house for 28 settings is now being constructed at Mariendorf, and for the new works at Weissensee a retort-house for ten settings is about to be commenced; while at one of the older works in the centre of Berlin it is contemplated to replace the whole of the existing carbonizing plant by this system.

It is unnecessary to enlarge upon the significance of these figures, as they speak for themselves. The good results obtained at the Oberspree and Mariendorf works, which have been already published, have been fully maintained. The average figures for Oberspree during April and May, 1908, after fifteen months' continuous working, were:

		April.		May.
Gas produced per ton of coal carbonized	cubic feet	13,185	..	13,205
Gas produced per retort	,,	15,434	..	15,539
Average heating value (60° Fahr. and 30 in. bar.)	B.Th.U.	555	..	554
Average illuminating power (60° Fahr. and 30 in. bar.)	candles	11·40	..	11·35
Description of coals used—				
English	per cent.	51·7	..	92·00
Westphalian	,,	31·9	..	—
Silesian	,,	16·4	..	8·00

At Mariendorf, where the verticals are in the same house as the slopers, it was not found feasible during the winter to separate the gas made by the two plants; but arrangements have recently been made to do so, and the results are similar to those obtained at Oberspree.

The testing-station of the German Association of Gas Engineers at Karlsruhe, which is under the supervision of Dr. Bunte, has just concluded some very careful and exact tests with the gas made at Mariendorf in the verticals. I have been enabled to obtain the results, which, however, have not yet been checked; but I believe Dr. Bunte has promised to forward the corrected results to the Committee on Carbonizing Methods, appointed by the Institution of Gas Engineers, as soon as they are ready. The coal used was exclusively Silesian.

Tests Made by the Testing-Station of Karlsruhe at Mariendorf.

		With Steam. May 18 to 22, 1908.		Without Steam. May 24 to 27, 1908.
Coal used	tons	388·2	..	334·1
Average weight of charge	cwt.	11·6	..	11·4
Gas production (at 15° C.)—				
Per retort in 24 hours	cubic feet	15,787	..	14,798
Per ton of coal carbonized	,,	13,707	..	11,375
Average heating power (at 15° C.)	B.Th.U.	551	..	601
Average illuminating power (at 15° C.) with Carpenter burner, 5 cubic feet	candles	11·89	..	15·87
Nitrogen	per cent.	1·40	..	1·10
Coke produced (dry)	,,	59·24	..	60·40
Breeze ,,	,,	5·09	..	3·30
Total	,,	64·33	..	63·70
Coke used for fuel	,,	14·00	..	14·23

At Cologne the retorts have been in action since August, 1907, and recent tests, made by Mr. Prenger, gave the following results:—

		Without Steam.		With Steam.		With Steam.
Duration of charge	hours	10	..	10	..	11
Duration of steam blowing	,,	—	..	2	..	2
Gas produced per ton of coal carbonized	cubic feet	11,931	..	13,068	..	13,616
Heating value (60° Fahr. and 30 in. bar.)	B.Th.U.	576	..	559	..	548

The chemical composition of the gas was as follows:—

	Without Steam. Per Cent.		With Steam. Per Cent.		With Steam. Per Cent.
CO_2	1·1	..	2·3	..	2·0
C_mH_n	3·5	..	3·0	..	2·6
CO	8·9		12·0	..	13·0
CH_4	28·8	..	26·2	..	22·9
H	53·7	..	52·5	..	56·1
N	4·0	..	4·0	..	3·4

At Mariendorf, carbonizing a mixture of 42·6 per cent. of West Pelaw Main, 51·4 per cent. of Upper Silesian, and 6 per cent. of Westphalian, with steam-blowing as above, the gas had a heating power of 561 B.Th.U., and its composition was as follows:—

	Per Cent.		Per Cent.
CO_2	2·2	CH_4	23·9
C_mH_n	2·8	H	55·2
O	0·6	N	3·6
CO	11·7		

At Dessau a test was made this month to find the quantity of gas which would be produced with Boldon coal of an illuminating power of 14 Hefner-candles at 0° C. with the Carpenter burner, which gives the following results:—

Coal carbonized	14·2 tons.
Weight of charge	9½ cwt.
Duration of charge	11 hours, including 2 hours' steaming.
Total gas production (at 15° C.)	208,020 cubic feet.
Production per retort	15,130 ,,
Do. per ton of coal carbonized	14,650 ,,
Heating power (at 0° C.)	589 B.Th.U.
Illuminating power (at 0° C.) with Carpenter burner (5 cubic feet)	13·6 Hefner candles.

A further test was to be made with an illuminating power, under English conditions, of 14 English candles at 15° C.; but the results have not so far come to hand.

Carbonization.—The emptying of the retorts proceeds with the utmost regularity and smoothness. No difficulty is found in maintaining the proper heats at the various parts of the retort. The maximum temperature in the furnace is kept between 1300° and 1350° C. = 2400° Fahr. The discharge of the coke is perfect. There are no stopped ascension-pipes; augering being required only once a week. The retorts require scurfing every six or seven weeks only, and this is a simple process; the bottom mouthpiece being left slightly open, and the top one covered over with an iron plate or some fire-bricks, with apertures so arranged that there is just sufficient draught to allow the carbon to be burnt off without overheating the retort, and no tool is required. The almost complete absence of any tools in the working of this system is one of its most striking features.

In order to prevent any undue pressure in the retort, especially at the bottom, a simple arrangement of screening the coal as it is delivered from the elevator, and before it enters the hoppers, has been devised, and gives excellent results. The coal, after being separated in the bunkers into nuts and fine coal, is fed into the retort in two parallel streams; and as the nuts form a column from top to bottom of the retort, the passage of the gas through the coal is thereby greatly facilitated.

Residuals.—Turning now to the residuals, better results are obtained in every item over those of any other system in use—viz., increased yield of ammonia, increased yield of tar of a better quality and fetching 25 per cent. more in value, and coke of better quality with less production of breeze. All of these points have been so lucidly enumerated in Mr. Körting's article on "The Dessau Verticals in Comparison with Other Systems, More Especially Slopers," published in the "JOURNAL OF GAS LIGHTING" on the 14th of January last. To compare the results as regards residuals and leaving out of the calculation the coal gas and water gas produced, the nine settings of slopers and the seven settings of verticals can be taken for the purpose, each plant carbonizing about 100 tons of coal in 24 hours. The results shown in Table I. are obtained.

The most noticeable feature in this table is the enhanced value of the coke, due to the large decrease in the quantity of breeze produced—viz., from 6½ to only 1½ per cent., on the coal carbonized—which is responsible for exactly the half of the total increased value of residuals. This total gain alone is sufficient to pay for the interest and amortization on the capital outlay for the settings and to leave a handsome profit besides. But the enumeration of the advantages of the system has by no means been completed. The important matter of labour will now be considered.

Labour.—This has been reduced to a minimum figure. At Oberspree there is one man per shift of eight hours for a production of 700,000 cubic feet of gas per diem; and at Mariendorf there are two men per shift of eight hours, or four men in twenty-four hours, for a production of 1,250,000 cubic feet per diem—a result which must appeal forcibly to even that great leader of the gas industry in England who recently expressed an opinion not altogether favourable to labour-saving appliances. Here is a system which, without any extraneous labour-saving machinery, but merely by placing the retort upright, and by the natural force of gravity,

TABLE I.—*Comparative Statement of the Results Obtained with Residuals in Nine Sloper Furnaces* (81 *Retorts*) *and Seven Vertical Furnaces* (84 *Retorts*). *Carbonizing Each* 100 *Tons of Coal in Twenty-Four Hours.*

SLOPERS.	Value of Bye-Products Per 100 Tons of Coal Carbonized. £ s. d.	Per Ton of Coal Carbonized. s. d.
Coke produced—		
63·5 per cent. on coal carbonized, less 12 per cent. for fuel = 51·5 tons at 20s.	51 10 0	10 3·5
Breeze produced—		
6½ per cent. on coal carbonized = 6·5 tons, at 5s.	1 12 6	0 3·9
Tar produced—		
4½ per cent. on coal carbonized = 4·5 tons, at 20s.	4 10 0	0 10·8
Ammonia produced—		
2·65 kilos. per ton = 265 kilos., at 6d.	6 12 6	1 3·9
Value of products		12 10·1

VERTICALS.	Value of Bye-Products Per 100 Tons of Coal Carbonized. £ s. d.	Per Ton of Coal Carbonized. s. d.
Coke produced—		
68·5 per cent. on coal carbonized, less 14 per cent. for fuel = 54·5 tons, at 20s. 6d.	55 17 3	11 2·0
Breeze produced—		
1½ per cent. on coal carbonized = 1·5 tons, at 5s.	0 7 6	0 0·9
Tar produced—		
5 per cent. on coal carbonized = 5 tons, at 25s.	6 5 0	1 3·0
Ammonia produced—		
3·2 kilos. per ton = 320 kilos., at 6d.	8 0 0	1 7·2
Value of products		14 1·1

INCREASED VALUE OF RESIDUALS DUE TO VERTICALS OVER SLOPERS.

Coke and breeze	7·5d. per ton of coal carbonized
Tar	4·2 " " "
Ammonia	3·3 " " "
Total	15·0d. per ton of coal carbonized.

gives a result which is of itself almost independent of labour at all. The following table shows the saving in carbonizing wages over slopers, under the same conditions as given for the Table No. 1 :—

TABLE II.—*Comparative Statement of the Cost of Carbonizing Wages Per Ton of Coal Carbonized for Nine Sloper Furnaces* (81 *Retorts*) *and Seven Vertical Furnaces* (84 *Retorts*) *Carbonizing Each* 100 *Tons of Coal in Twenty-Four Hours.*

SLOPERS.	Total Cost per Day. £ s. d.	Per Ton of Coal Carbonized. Pence.
3 foremen, at 6s.	0 18 0	2·2
9 stokers, at 5s. 6d.	2 9 6	5·9
2 clinkerers, at 5s. 6d.	0 11 0	1·3
Cost of labour		9·4

VERTICALS.	Total Cost per Day. £ s. d.	Per Ton of Coal Carbonized. Pence.
2 foremen, at 6s.	0 12 0	1·4
4 stokers, at 5s. 6d.	1 2 0	2·6
1½ clinkerers, at 5s. 6d.	0 8 3	1·0
Cost of labour		5 0

Saving in labour with verticals, 4·4d. per ton of coal.

NOTE.—The figures for the verticals do not represent the limit which can be attained with the same number of men. Comparing the two systems on the basis of men-hours, the verticals would show an economy of about 68 per cent.

The simplicity and smoothness in working appeal to all who have seen the system in action. A visitor from England recently said to the writer: "This is simply marvellous; you have only one man for all these furnaces, and even he has nothing to do." This was in point of fact a slight exaggeration; but when compared with the work of the stoker at the horizontals or slopers, the easy time he has of it strikes one very forcibly.

Purification.—One remarkable feature of the influence of the vertical system on purification is the considerable decrease in the amount of bisulphide of carbon in the gas. Recent tests of the gas at Oberspree (using Lambton coal alone) have given not more than 12 grains of sulphur per 100 cubic feet—and this with oxide purification only. At Cologne, Mr. Prenger found 17·35 grains per 100 cubic feet, as compared with an average of 30·59 grains in former times. The amount of cyanogen found there at the inlet condensers is now 79·62 grains per 100 cubic feet, compared with 104·9 grains under the old conditions. There is scarcely any formation of naphthalene, so that the oil necessary for its extraction is no longer required; and the cost of erecting naphthalene washers is, in consequence, saved.

Wear and Tear.—The important factor of wear and tear shows every indication of being reduced with verticals. At Oberspree, where, as already stated, the retorts have been at work continuously for the last 15 months, there are no signs of any deformation at all; and it is reasonable to expect that the life of the retort will be quite as long as, if not longer than, that of slopers, and that the total outlay on wear and tear will show the same reduction over slopers as did the latter over horizontals with hydraulic stokers. In these vertical retorts only the lower part is exposed to the full heat; and it is easy to get at in case of any repairs being necessary. One might have thought that the apparently complicated arrangement for actuating the bottom mouthpieces would often get out of order; but this is not the case. They are not subjected to any rough treatment by the stokers as are the mouthpieces of the Coze furnaces; and the simplicity, smoothness, and cleanliness of the work will in all probability conduce to a diminution of wear and tear also. Stokers' tools have nearly all been discarded, and the hot coke conveyor is in action for a shorter time than is the case with slopers, and therefore cannot have the same wear and tear. The following table will be interesting as showing how during the last five years the amount spent on wear and tear per 1000 cubic feet for carbonizing plants at Berlin shows a diminution with every improved system. The inclined retorts show a large reduction in this respect; and the verticals may be expected to show a very considerable improvement even on this.

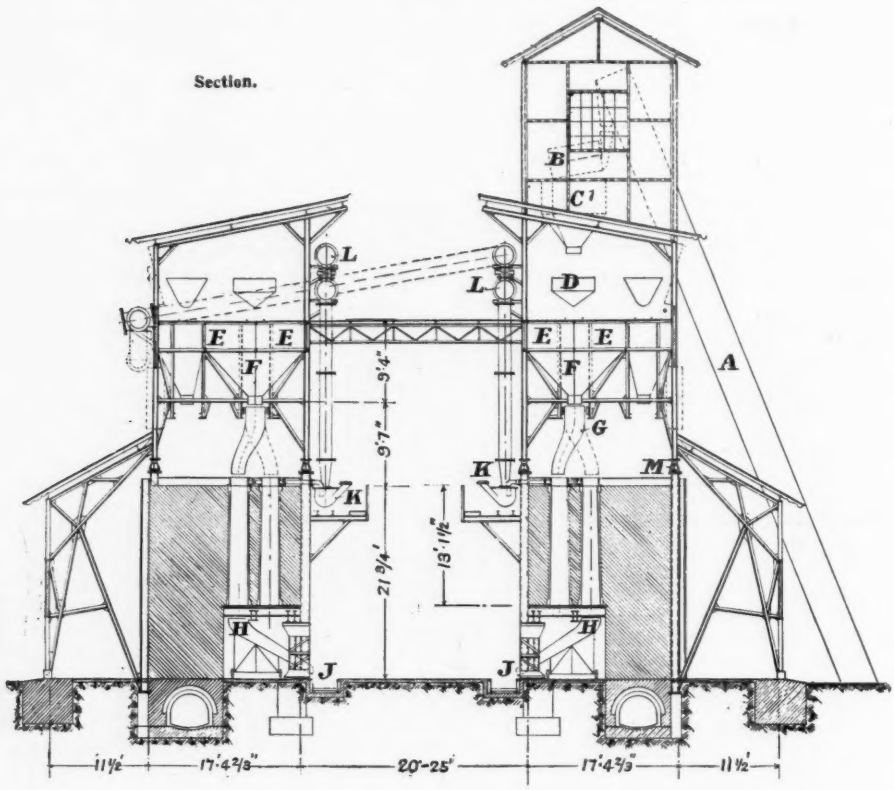
TABLE III.—*Average Amount Spent on Wear and Tear in Berlin during the Last Five Years per* 1000 *Cubic Feet of Gas Produced.*

—	Retort Beds.	Stokers' Tools, &c.	Hydraulic Stoking Machinery.	Mechanical Coke Conveyor.	Trolleys or Wheelbarrows.	Total.
	d.	d.	d.	d.	d.	d.
Fire-bar furnaces	0·74	0·40	..	..	0·08	1·22
Horizontals with producers and hydraulic stoking	0·77	0·31	0·12	..	0·09	1·29
Coze furnaces	0·52	0·27	..	0·10	..	0·89
Vertical furnaces (estimated)	0·27	0·13	..	0·07	..	0·47

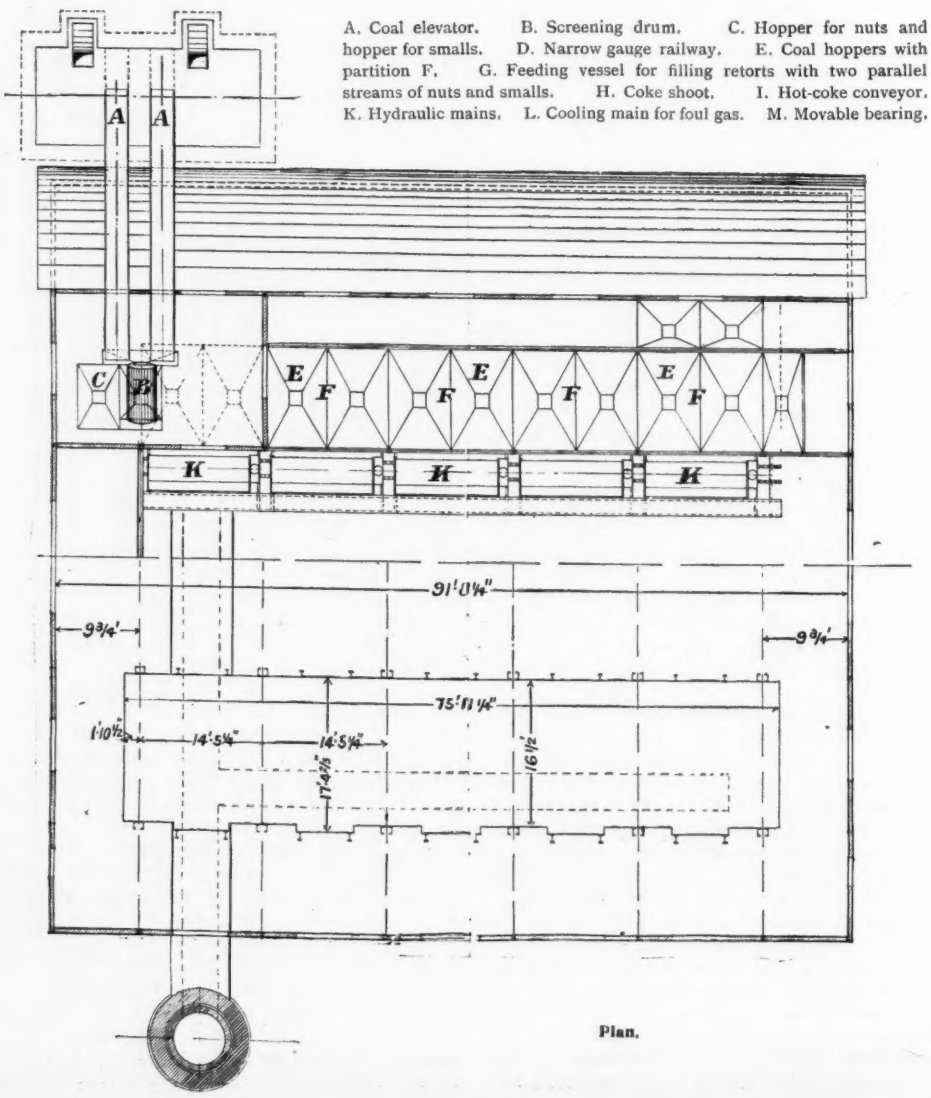
Retort-House.—At Berlin, the aim has been to have as much air and light as possible in the retort-houses. House No. 1 at Mariendorf, built for slopers, marks a considerable advance on former practice. Even in the hottest weather the smoke and dust incidental to charging retorts are at once carried off, and the stokers are able to work in comfort. The new vertical house is a still further improvement on House No. 1. The stoker who empties the retorts is well out of the way of the steam and dust of the De Brouwer trough; and the charger has a row of windows (which can be open or shut at will) on one side of him, and on the other side there is a free space extending right across the house. On the stage above, where the coal is brought to the hoppers, there is the same arrangement for ventilation; and the lean-to under which the clinkerer works has numerous sliding doors, so that he can have as much fresh air and light as he likes. For the rest, the writer would refer members to the diagram accompanying the paper, merely remarking that the house in question will, he believes, prove to be cheap to build and to maintain.

Illuminating Power.—In Germany, the scientific mind of the people leads them quite naturally to seize on every method of practising economy with due regard to efficiency. This is observable in every form and mode of life, and especially has it been the case with regard to the use of gas. The wonderful invention of Auer von Welsbach showed them the way, and they were quick to follow it; and to-day the flat-flame, or even the argand burner, is practically unknown. Not only is the incandescent burner omnipotent, but the demand for the very latest improvement of the same—viz., the inverted burner—is increasing very rapidly.

RETORT-HOUSE FOR DESSAU VERTICAL FURNACES.

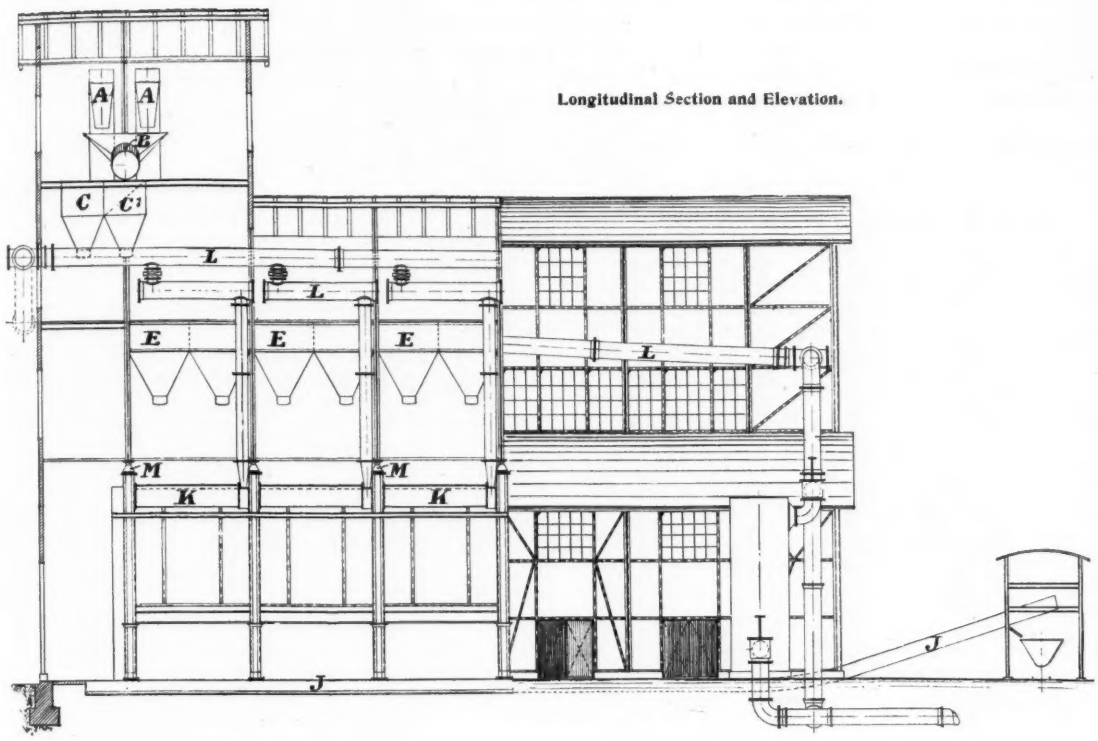


A. Coal elevator. B. Screening drum. C. Hopper for nuts and hopper for smalls. D. Narrow gauge railway. E. Coal hoppers with partition F. G. Feeding vessel for filling retorts with two parallel streams of nuts and smalls. H. Coke shoot. I. Hot-coke conveyor. K. Hydraulic mains. L. Cooling main for foul gas. M. Movable bearing.

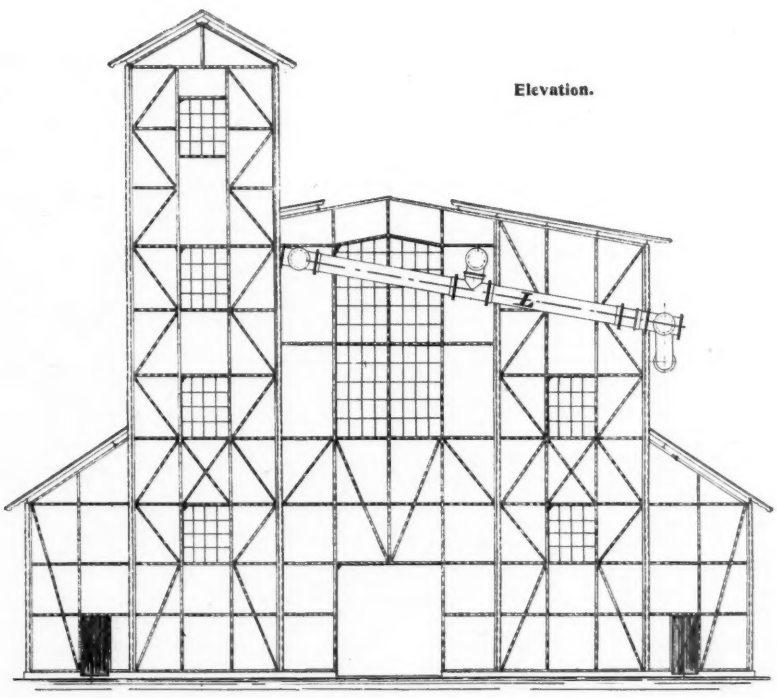


Plan.

RETORT-HOUSE FOR DESSAU VERTICAL FURNACES.



Longitudinal Section and Elevation.



Elevation.

Where is it possible to find a better lighted city than Berlin? And this result is achieved with low-grade gas! The beautiful display of inverted high-pressure lamps, which have been recently installed, gives an effect far surpassing anything that can be obtained with the electric light, and is one of the most remarkable developments in gas lighting of the present day. Many members will shortly have an opportunity of seeing and judging it for themselves.

If on their return they can induce their directors and members of committee to come over and see what is being done in Germany to-day, the writer thinks they will go back and try to influence their legislators to take a broad-minded view of the whole question of gas supply, and to modify those restrictions with regard to illuminating power, &c., which are no longer compatible with modern requirements, and to introduce conditions which will eventually tend to benefit the great mass of the people for whom gas is one of the necessities of life. What is it that the consumer wants, having regard to the present development of gas lighting? He requires for his sensitive inverted burner a gas of unvarying calorific power, specific gravity, and pressure. At Mariendorf and at Oberspree, by means of strict supervision, we have succeeded in maintaining the uniformity of the gas in a remarkable degree. The difference between the old and new conditions is this: That whereas there were variations from between 560 to 620 B.Th.U., the supply is now from 550 to 560 B.Th.U., with almost perfect regularity; and this is amply sufficient for all purposes. It appears to the writer that to produce gas of this description, the vertical furnace is the best and most economical system.

[On being called upon by the President to read his paper, Mr. Woodall remarked that he had watched with the greatest interest the work of Dr. Bueb and Herr Körting; and he congratulated them and Mr. Hayman on being able to present so promising and so splendid a record as the last-named gentleman had just done.]

CONTINUOUS CARBONIZATION IN VERTICAL RETORTS.

By H. W. WOODALL, of Bournemouth.

The carbonization of coal in horizontal retorts has been carried on for the past century, and the present position of retorting is due to the united efforts and experience of thousands of engineers, inventors, and manufacturers who have had the benefit of the experience gained in the use of plant which has been in operation for many years, and on which vast sums have been expended. The experience with nearly all the improvements introduced into gas-works practice during the above period (stoking machinery, inclined retorts, &c.) has been that the originators have introduced new plant, the complete success of which has only been arrived at as the result of practical experience on the works; for it is only there that those small details on which the most efficient working of the plant is so dependent, can be finally worked out.

The gas industry is at present entering upon a most interesting period of its history. Several new methods of carbonizing are being introduced, each possessing special features of its own, and showing promise of improvement over existing methods. Among these is continuous carbonization in vertical retorts, and—while the writer would have much preferred that the presentation of the first practical paper on this subject should have been deferred until such time as an independent author could be found who had practical experience of the working of this system on a large scale—he recognizes with some reluctance that at the present moment Mr. Duckham and he appear to be the only persons in a position to read a paper on the subject. Under these circumstances, he cannot but accede to the courteous request of the Council for a paper on continuous carbonization; and if the following brief history of the system with which Mr. Duckham and he are associated should appear to be lacking in detail or finality, it should be remembered that this paper deals with a process which, while a radical departure from existing methods, is to-day only in its infancy.

In 1902 the Bournemouth Gas and Water Company purchased the undertaking of the Poole Gas Company; and as the site of their works offered better facilities for the unloading of coal than the Bournemouth works did, it was decided to erect a new gas-works at Poole, and to make gas there for both Poole and Bournemouth.

While studying the various systems of carbonization then existing, an idea struck the author, of a process in which it would be possible to manufacture coal and water gas continuously in the same closed vessel. It was an attractive scheme; but there were elements of danger connected with the working that led him to ask Mr. Head (now of Winchester) and Mr. Duckham, both then officials of the Bournemouth Gas and Water Company, if they would care to work such a plant. They were polite as always, but very firm; and the author went away to think out the problem afresh. Shortly after this, Mr. Duckham brought forward a suggested scheme for the continuous carbonization of coal in vertical retorts; and it was on the lines of this suggestion that the process subsequently developed.

An ideal system was pictured, to obtain which there seemed to be three separate conditions required, which were as follows:—

(1) Continuous and constant working—to be obtained by removing the coke continuously and by supplying sufficient coal to keep the retort full to the coal inlet; the speed of coke extraction governing the working of the retort.

(2) Making use of the heat of the coke which is usually wasted in quenching to generate steam, which steam prevents loss of gas at the bottom, and can be subsequently converted into water gas in the retort if desired.

(3) Heating the retort most highly at the top immediately after the coal has entered; the idea being to drive the gas off as soon as possible, so that it should have the shortest possible travel through or over hot material before leaving the retort.

It was in pursuit of these three conditions that our work has been conducted, and in their attainment that success has been achieved.

The First Experimental Setting.—This was erected in November, 1903; the retort being 10 feet long, circular in section, and 15 inches in diameter at the top and 18 inches at the bottom. The coke conveyor was of the carrying type, and ran at a speed of about 20 feet per hour. The mouthpiece and feed roll were heavy and cumbersome; and when trouble arose it was not easy to gain access through them to the retort.

Very little was known about the heating of vertical retorts in those days, and the heats hung for some time. One Saturday afternoon, however, they started moving up with a rush, and a danger was felt in leaving the retort uncharged. We started work very early next morning, and had no doubt that the next few hours would set the seal upon the successful introduction of continuous carbonization. Very late that night, two dirty, tired, and hungry individuals decided that the solution must be left for the following day. This was in November, 1903! The

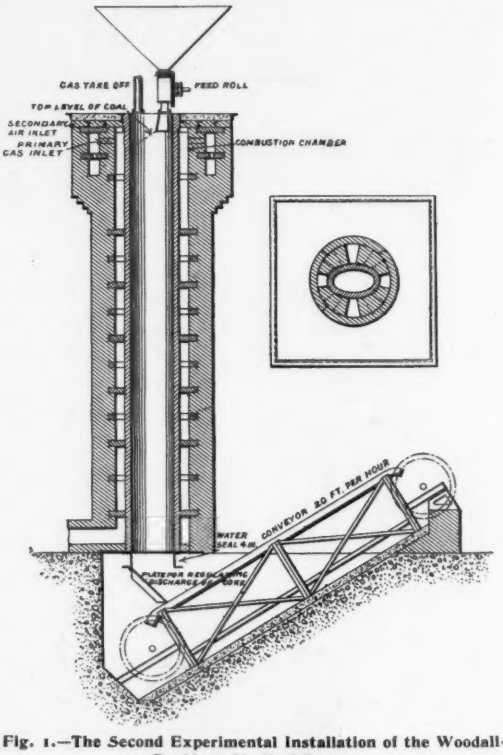


Fig. 1.—The Second Experimental Installation of the Woodall-Duckham Vertical Retort.

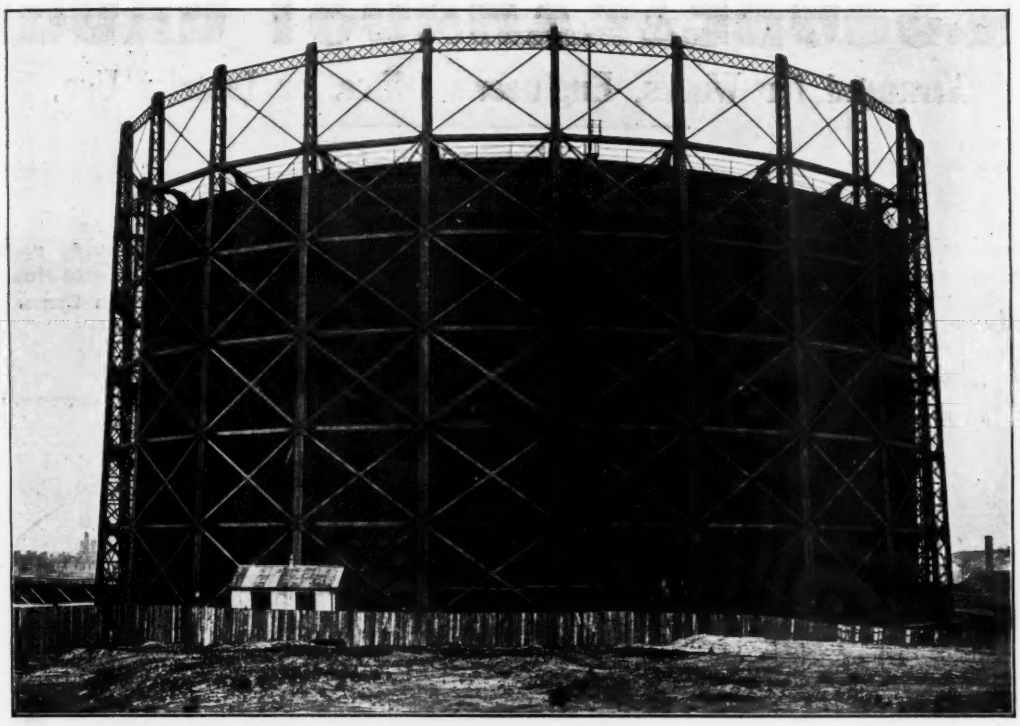
retort was worked for three weeks, but never really carbonized any coal. The chief defect was that so great an amount of steam was generated in the water sump, and the heating of the retort was so defective, that the steam ascended through the retort unchanged, and reduced the temperature of the charge to such an extent as to prevent carbonization. Though very disappointed, Mr. Duckham and the writer realized the chief defects in the process, and were sanguine of its eventual success with an apparatus modified as experience dictated.

The Second Experimental Setting.—It was not until September, 1904, that the second plant was put to work; there having been considerable delay in obtaining materials. This plant is shown in the first diagram. The retort was 20 feet long and oval in section instead of round; the dimensions being 24 inches by 10 inches at the top and 24 inches by 18 inches at the bottom. The combustion chamber was at the top of the setting, and there was practically no regeneration; the flue gases descended around the retort, their passage being baffled by the horizontal supporting tiles. The top ironwork was simplified, but the same coke conveyor was used as with the first retort.

The first trial of this retort was from Sept. 14, 1904, and lasted for about two months. The chief difficulty

"VITERNUS" REGD. STEEL COMPOSITION

Used on ST. ANTHONY'S GASHOLDER, NEWCASTLE-ON-TYNE.



Nat. Tel.: No. 1759.

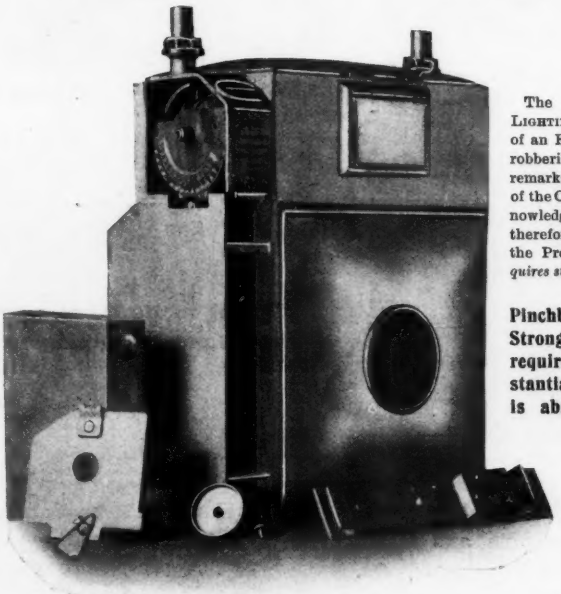
Telegraphic Address: "Enamel" Manchester.

Manufactured solely by **JOHN E. WILLIAMS & CO.,** Victoria Paint, Color, & Varnish Works, MANCHESTER, ENG.

Established 1844. **PINCHBECK'S** Telephone 2367 North.

BURGLAR PROOF STRONG BOX

(Registered No. 498,410.)



The "JOURNAL OF GAS LIGHTING," in the course of an Editorial Note anent robberies from Slot Meters, remarks: "The Flimsiness of the Coin Meter is the acknowledged tempting fault; therefore, the Coin Box of the Prepayment Meter *requires strengthening.*"

Pinchbeck's Slot-Meter Strong Box meets this requirement. It is substantially made, and is absolutely burglar proof.

Full Particulars of this and other Specialities on Application to

J. PINCHBECK & CO., (The Original Makers of the Box Float), **ADAMS PLACE, GEORGE'S RD., HOLLOWAY, N.**

SUGG'S
PRESSURE & EXHAUST GAUGES

Arranged for Works, Engineer's Office, or District Use.

To accurately register all Pressures up to 5 lbs. per square inch.

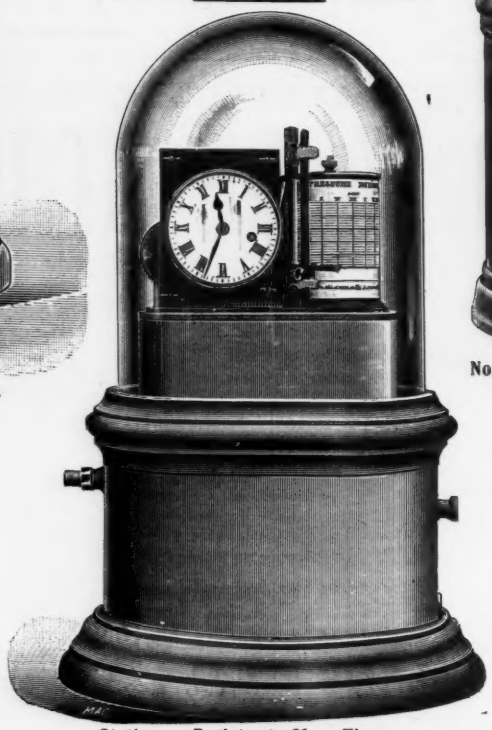
No. 250. 24-Hour Dial Register.

To continuously register Pressures for 24 Hours or Seven Days.

No. 233. 24-Hour Stationary Register.
THE CHEAPEST & BEST REGISTER ON THE MARKET

No. 257. Seven-Day Stationary Register.

Fuller Particulars and Prices on Application.



Stationary Register to Show Time.

English made Movements with Lever Escapements.

Catalogues showing latest pattern Photometers, Metropolitan Argand No. 2, Harcourt's 10-Candle Pentane Lamp, Calorimeters, Standard Measures and Gasholders, Standard Minute Clocks, Gas Analysis Apparatus, &c.

WILLIAM SUGG & Co., LIMITED, ENGINEERS, VINCENT WORKS, WESTMINSTER, S.W.

experienced was that the charge hung up in the top length of the retort. This hanging-up was caused by the bad shape of the retort; and so bad did the trouble become that in November new pieces of retort were ordered and the setting let down. The plant was put to work again on Jan. 17, 1905, and worked continuously till April 23. The heating of this retort was faulty at first; there being practically no regeneration. But on heating the secondary air by passing it through a wrought-iron tube heated by a single-ring burner, the heats increased greatly; first-class working was obtained; and for six weeks the retort worked without being touched in any way whatever. The working of this plant proved that continuous carbonization was attainable; and so promising were the results that the Directors at Bournemouth decided to put up a setting of four retorts to try the system on a larger scale.

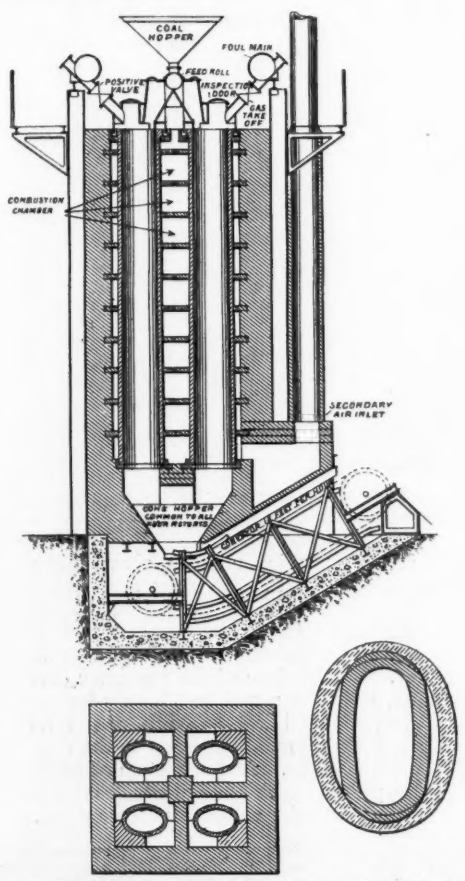


Fig. 2.—The Third Experimental Installation of the Woodall-Duckham Vertical Retort.

The Third Plant.—The third plant is shown in the second diagram. In designing it, simplicity of construction was the chief point aimed at; and for this reason it was decided to run the bottoms of the four retorts into one discharging hopper, and to have a single conveyor removing the coke instead of providing a separate conveyor for each retort. The retorts, 20 feet long, were oval in section, 24 in. by 10 in. at the top, and 27 in. by 20 in. at the bottom. They were hand made and heated by three combustion chambers, the gases from which mixed and were directed around the retorts in their descent by means of the supporting tiles. One feed roll served for two retorts, and all the mouthpieces and top ironwork were carried clear of the brickwork; the joints being made by the spigots of the mouthpieces fitting into sockets on the retorts, the space between being packed with lime. A door was provided for convenience of scurfing and filling the retorts when starting up. The brick hopper into which the four retorts discharged was finished at the bottom by a cast-iron hopper mouthpiece 24 in. square. A conveyor, 24 in. wide, of the plate-carrying type, removed the coke and ran at an average speed of 18 feet per hour. This plant worked for about twelve months. It was started in June, 1905, and worked continuously until September, when it was shut down and restarted on Oct. 9, 1905, and worked continuously until August, 1906.

The great fault with this setting was that, with four retorts working into one hopper, one or other of the retorts would sometimes establish a flow of coke direct to the mouth of the hopper, and so fill the conveyor to the exclusion of the remaining retorts. Another difficulty was that one of the retorts had a twist in it very detrimental to the continuous sliding of the charge; and it was eventually found necessary to fill this retort solid and work only three retorts. There was still too much steam ascending the retorts—more indeed than the heat in the coke could properly break up into water gas; and the percentages of carbonic acid were consequently high, averaging from 4 to 6 per cent. The coke after being immersed for some twenty minutes was wet (friends said "too wet"); but we fired the producer with some of it and sold the rest after stocking.

This plant showed that the problems to be faced were heavier than had been anticipated; but the results were satisfactory, and it was felt that all the mechanical difficulties could be accounted for and overcome. It was evident, however, that success could not be hoped for if so wide and involved a question received only intermittent attention. Investigation had proceeded to such a length, and the problem had proved so absorbing, that Mr. Duckham and the writer were disinclined to abandon the work when it was showing promise of success; and after somewhat anxious consideration, it was arranged that Mr. Duckham should resign his post of Assistant-Engineer to the Bournemouth Gas and Water Company and devote all his time to the problem of continuous carbonization.

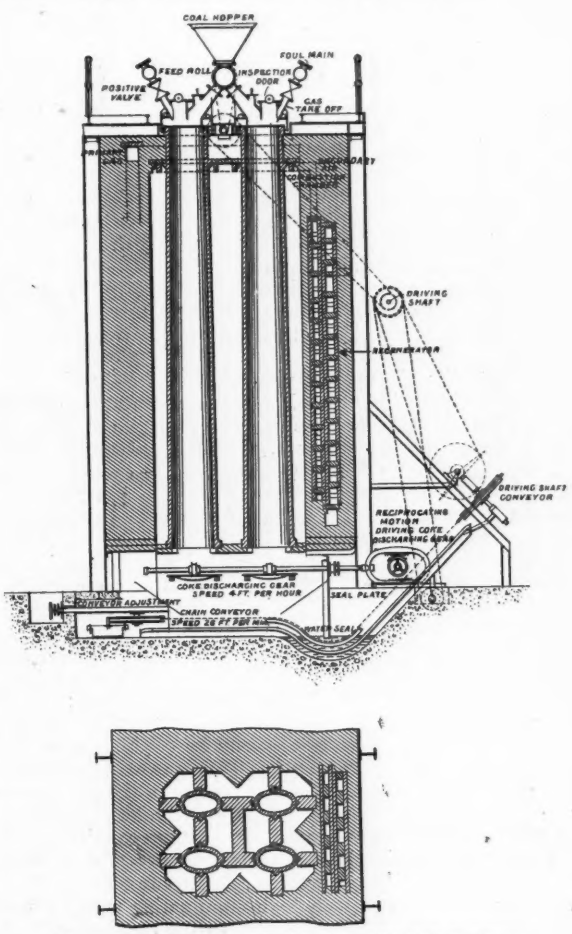


Fig. 3.—The Fourth Installation of the Woodall-Duckham Vertical Retort.

New Plant at Bournemouth.—Designs were prepared for a new plant, and on inspecting these the Directors at Bournemouth decided to erect a bench comprising four settings, each of four retorts, at their Bourne Valley works. About this time Mr. Goulden, of the Gaslight and Coke Company, and Mr. Allen, of the Liverpool United Gaslight Company, reported favourably on the process to their respective Boards, and both Companies decided to erect installations, each of two settings of four retorts.

In order to overcome the hanging-up of the coal in the retorts, and to ensure that the retorts were perfectly true,

they were made by machine in short sections. The length of the retort was increased to 25 feet with the idea of decreasing the percentage of CO_2. A discharging device was provided, which ensured a continuous and equal discharge from each retort; and this worked in conjunction with a coke removing conveyor which worked dry, or nearly so, in a hopper under the retorts and brought the coke out quickly through a water seal. The retorts were oval in section, 24 in. by 10 in. at the top, and 30 in. by 22 in. at the bottom. The combustion chamber was 4 feet from the top of the retorts; the idea of lowering this being that the layer of cool coal at the top of the retort would condense out some of the tar formed.

The top ironwork was very similar to that of the previous setting, only somewhat simplified, and a ball-joint arrangement was introduced to enable the attendant to insert a rod into the retort conveniently and without loss of gas. Under the bottom of each retort was a plate on which the charge in the retort rested. Over this plate reciprocated a pusher-head mounted on a rod in tandem with the other retort on the same centre. The two rods from each setting came through stuffing-boxes on the seal-plates in the front of the bottom hoppers, and were connected to a crosshead, which was reciprocated by means of a double rack and half pinion device at a speed of one forward and backward stroke per hour. On the bottom of the hopper into which the coke was discharged by the pushers, a scraper conveyor worked, travelling at a fairly high speed—25 feet per minute—and brought the coke out through the water in about fifteen seconds. A great deal of trouble was experienced with the bottom conveyor; and it was not until this had been entirely reconstructed that it could be got to work. Another trouble was that the coal in the top 4 feet of the retort became very sticky, and the sides of the retort being comparatively cool, it stuck to them; and this necessitated a certain amount of rodding from the top.

The plant at Bourne Valley was started up in January, 1907, and worked until the Bournemouth works were shut down during the summer, when all the gas required to supply the district was being made at Poole. The plant was started up again on Oct. 16, 1907, since when it has run, and is still running, satisfactorily. Before restarting, the combustion chamber was raised to as near the tops of the retorts as possible, and this has greatly improved the working.

Plant at Nine Elms.—The plant erected for the Gaslight and Coke Company at their Nine Elms station caused a great deal of worry and annoyance owing to the constant failure of the bottom conveyors. These were badly strained at starting and were never satisfactory. The tests carried out by the Company, however, demonstrated the possibilities of the system, if only the trouble with the bottom conveyors could be overcome.

Plant at Liverpool.—The plant erected at Liverpool was even more unfortunate. The same difficulties were experienced with the conveyors, and in addition to this serious trouble with leaky retorts occurred. The surrounding brickwork, which had been erected in common brick, expanded and caused the retorts to part at their top joints. The retorts were let down and temporarily repaired; but it was evident that the only way to permanently overcome the trouble would be to reset the top sections of the retorts free from the surrounding brickwork. This was arranged to be done with Mr. Allen's permission; but when the time came for putting the work in hand, Mr. Allen said that, in view of the fact that the standard in Liverpool is 20 candles tested in a flat-flame burner, he did not consider it advisable to expend more money on the settings, as he felt that only a gas yielding a comparatively high illuminating power when tested with a flat-flame was suited to the requirements of his Company.

Improved Method of Discharging.—After making the modifications resulting from the extended experience with the bottom conveyors at Bourne Valley, there is now little trouble with them; but the fact remains that they require a a good deal of knowing, that they are clumsy in appearance, that they are costly to maintain, and that the coke is still rather wet, although the time occupied in passing through the water seal is only from ten to fifteen seconds.

It had been evident for some time that the future success of continuous carbonization was more a question of mechanics than retorting, and for the above reasons it was felt that some radical alterations must be made to the bottom gear. After considering several schemes, it was finally decided to adopt the bottom arrangement that is in operation at Poole at the present time. This arrangement is shown in the fourth diagram.

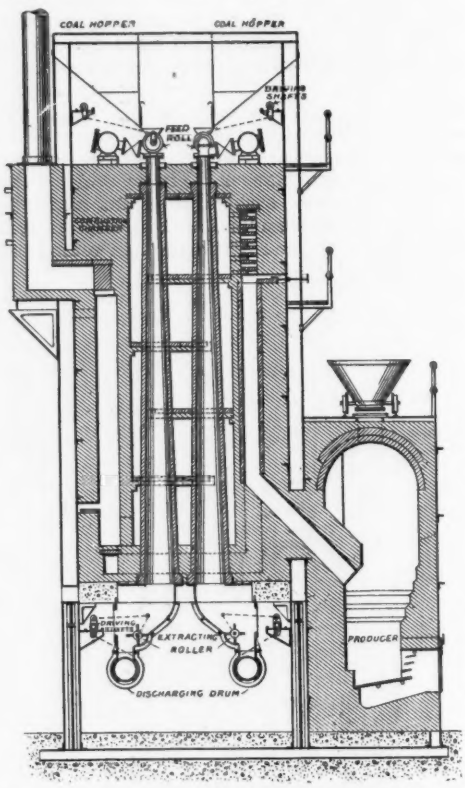


Fig. 4.—The Improved Method of Discharging the Woodall-Duckham Vertical Retort.

The coal-feeding device remains practically unaltered with the exception that the drive has been simplified, and the coal-hopper has been set back so that the coal-feeding device is quite get-at-able at any time, whether the hopper is full or not. The principle of the old discharging device is maintained. But in place of the pushers a curved plate with a special roller extractor has been adopted; and in place of a conveyor and water seal, there is a rotary self-sealing discharging drum. Reference to the diagram will explain this more clearly. At the bottom of each retort is a cast-iron hopper, the back plate of which is curved and of such a slope that the coke would discharge direct into the

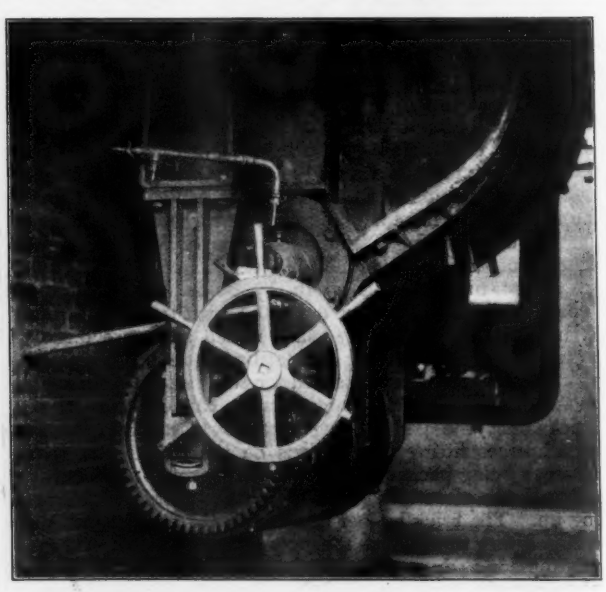


Fig. 5.—Bottom Extractor Casting, Poole Works, for the Woodall-Duckham Vertical Retorts.

discharging drum were it not for the rotary extracting device which is placed at the foot of the slope. The extracting device restrains the free flow of coke, and only

allows such an amount to pass into the discharging hopper as is fed over by the star-shaped arm as it rotates.

The coke is quenched by means of a water spray discharging immediately over the extracting device, and using one gallon of water per retort per hour, or about 8 gallons per ton. At Poole, using 8 cwt. charges in horizontal retorts, there are automatic cisterns for quenching which contain 16 gallons of water, or in other words 40 gallons of quenching water are used per ton of coal, or five times as much as in the verticals.

From the above brief history, it will be seen that starting with a simple form of apparatus, mechanical devices were gradually added until the desired result of continuous carbonization was attained. From this point the plant has been simplified until an apparatus has been arrived at which, while maintaining all the advantages of continuous carbonization, is simpler than the first trial setting, more certain in action, and much less expensive to maintain.

Results.

The vertical retort installations have all along been worked through separate condensers, washers, scrubbers, and station meters, the latter having in each case been overhauled, tested, and adjusted by Messrs. Parkinson and W. & B. Cowan before being used.

In the case of the four settings of four retorts at Bourne Valley, the gas is passed through an 18-inch condenser outside the retort-house, a Livesey washer, a Cutler water-cooled condenser, and a Kirkham-Hulett rotary washer-scrubber, all of a capacity equal to 1½ million cubic feet per diem; then through a set of four 25 feet square oxide purifiers, and lastly through about 300 yards of 24-inch main to the station-meter. The tests for illuminating power, calorific power, &c., are taken from a short service, just before the station-meter. This service is connected through a water bottle to the inlet of the exhausters, so that gas is always passing through it at a comparatively rapid rate, and a fresh sample is ensured at each testing.

For the single retort at Poole there is a special testing plant consisting of a condenser, exhauster, Livesey washer, two tower scrubbers, and a station-meter. Special tanks are arranged, so that the tar and liquor for each 24 hours can be measured and sampled separately.

First Single Experimental Retort.—This retort was put to work in November, 1903, and no results worth recording were ever obtained.

Second Single Experimental Retort.—This retort was put to work in September, 1904, and worked for about two months. The plant was put to work again in January, 1905, and worked continuously until the end of April. The illuminating power of the gas made was very low, averaging 12-candle power after the CO_2 had been removed, and there is no doubt that a great deal of water gas was being made at this time. Taking the working of this retort over a period of two months, the following results were obtained:—

Coal carbonized	90·66 tons
Gas made	1,717,210 cubic feet
Average make per ton	18,941 ,, ,,
Illuminating power after removal of CO_2	12·29 candles

First Setting of Four Retorts.—This setting again gave very high makes per ton. From Aug. 15 to Sept. 12, 1905, the result was as follows:—

Coal carbonized	190·33 tons
Gas made	3,502,340 cubic feet
Gas made per ton	18,403 ,, ,,
Illuminating power after removal of CO_2	12·04 candles
Calorific power	513 B.Th.U.

In this setting, as in the previous one, a very large amount of water gas was formed. Other residuals were: Tar, 15 gallons per ton of specific gravity 1·05; ammoniacal liquor, 60 gallons of 8 oz. liquor per ton; naphthalene, none.

Later Settings of Four Retorts at Bourne Valley.—Previous tests have already been published, but from Christmas, 1907, to the time of writing, and with only two settings in operation during part of the time, the results have been as follows:—

Coal carbonized	1731 tons
Gas made	22,832,000 cubic feet
Gas made per ton	13,190 ,,
Illuminating power tested on Carpenter's No. 2 "Metropolitan" burner after passing through oxide only	14·1 candles

The coal used has been stored in the open for a considerable time, and was very dusty and often very wet. No allowance was made for moisture. During the above period the coals used were as follows:—

	Tons.	
Earl of Warwick and Dunkerton	916	In store ten months.
Acton Hall and Aldwarke Nuts	815	In store twelve months.

One of the most satisfactory results of the past few months working of the retorts at Bourne Valley has been the demonstration of the fact that Somerset coal, such as Earl of Warwick and Dunkerton, can be carbonized without trouble. These coals swell considerably in the retorts; and at Poole, where a De Brouwer discharger is used, it is found necessary to mix the Somerset coal with an equal quantity of nuts if smooth working is to be obtained in the horizontal retorts. With continuous working in vertical retorts, if a coal is being carbonized which expands considerably in the retort, space is always allowed for this expansion by the removal of the coke from the bottom of the retort; and the admission of further coal is automatically checked by the expansion of the coal already in the retort till such time as sufficient coke has been removed from the bottom to permit of the entry of a fresh charge. This is an important function of continuous carbonization, as it enables any class of coal to be used no matter how much it swells on heating.

Plant at Nine Elms.—The following tests obtained by the Gaslight and Coke Company at their Nine Elms Station have already been published in the "Journal of Gas Lighting." The coal used had been stored in the open and was wet; but no allowance was made for moisture. The analysis of the gas is particularly interesting, showing as it does that the gas is for all practical purposes pure coal gas, the low carbon monoxide figure showing that water gas was practically absent.

Coal used, Birley Silkstone	86·3 tons
Gas made	1,072,294 cubic feet
Gas made per ton	12,423 ,,
Illuminating power	15·82 candle power
Sperm value	674
Calorific value—Gross	596·6 B.Th.U.
,, Net	530·7 ,,
Composition	
Carbon dioxide	2·22 per cent.
Hydrocarbons	2·88 ,,
Oxygen	0·27 ,,
Carbon monoxide	7·41 ,,
Methane	35·05 ,,
Hydrogen	45·85 ,,
Nitrogen	6 32 ,,

Yield of Gas.—It will be seen from the results that the yield of gas per ton was satisfactory from the very first. It was evident, however, that it was not desirable to continue to make so large an amount of water gas in the retort, and the reduced make per ton in the later plants is not due to the vagaries of a new system, but is the result of a deliberate and intelligent policy. That the first effect should be a serious diminution in make per ton was unavoidable: but this loss is counterbalanced by an increase in the amount of coke available for sale, and from present working it would further appear that the initial reduction does not represent a permanent set-back, as the make of gas per ton is steadily improving.

The trial retort at Poole fitted with the new coke extracting device was put to work on Nov. 7, 1907. Since then, it has been let down several times in order to effect alterations and modifications, the advisability of which had been demonstrated in working. Under these circumstances, it is not possible to furnish results obtained over any extended period of working.

The figures obtained on the setting of four are, however, fully borne out; and there is reason to anticipate that with the settings as modified the results will be much improved, and the throughput of the retort will be increased. On several days the single retort has carbonized over 3 tons of coal, and the average amount for 24 hours is 50 cwt.

Latest Results.—The last alteration to the bottom work was made on May 12. Since then, results up to the time of writing have been as shown in the following table. In view of the short period over which the figures have been obtained, the writer submits them for what they are worth, and without comment.

Cost of Working.—In his valuable contribution to the "Journal of Gas Lighting" on the question of vertical retorts for the production of illuminating gas, Mr. Herring (considering the problem from the point of view of the shale oil industry) writes:—

> "The fascinating part of this problem undoubtedly lies in the possibility of increasing the yield of gas by the conversion of the heat units (otherwise lost in the spent charge) into water gas at the base of the retort."

Poole Vertical Retort—May 12 to 21, 1908.

Date.	Coal Used.	Gas Made.	Gas Made Per Ton.	Illuminating Power. [CO_2 left in.]	Calorific Power. [CO_2 left in.]	CO_2.	Coke Made.	Coke Per Ton of Coal.
	Tons. Cwt. Qrs.	Cubic Feet.	Cubic Feet.	Candles.	B.Th.U.	Per Cent.	Cwt. Qrs. Lbs.	
May 12	2 11 0	36,290	14,231	14·40	No record	1·8	36 0 7	
,, 13	2 13 0	36,900	14,717	13·70	,,	2·5	37 1 7	
,, 14	2 12 0	36,650	14,095	14·30	,,	1·3	36 0 15	
,, 15	2 13 0	38,200	14,416	14·40	,,	2·0	36 2 19	
,, 16	2 7 2	33,160	13,962	14·80	,,	1·8	34 3 13	
,, 17	2 10 0	35,460	14,184	14·50	566	1·5	35 3 18	
,, 18	2 10 2	36,950	14,633	14·00	552	1·7	37 0 6	
,, 19	2 13 0	36,850	13,906	14·00	547	1·2	36 3 10	
,, 20	2 9 0	33,200	13,551	14·50	545	1·7	33 3 24	
,, 21	2 11 0	35,350	13,863	14·00	546	1·8	35 1 14	
Totals	25 10 0	361,210	14,165	14·26	551	1·73	360 0 21	14·11 cwt.

From correspondence that has appeared in the Technical Press from time to time, it would appear that an opinion prevailed that it was desired to make water gas in vertical retorts through the medium of heat transmitted from the setting into the retort for this special purpose. This was never our intention; all that it was desired to do being to utilize the heat in the coke in exactly the manner described by Mr. Herring, and to limit the production of water gas to this amount. It was the fact that the quantity of steam formed could not be limited which led to the low illuminating power, and to the high amount of CO_2 present in the gas made in the first settings; and the writer is confident that where a considerable quantity of water gas is required, the best method of obtaining it is by means of special plant and apparatus, and not by means of coal-gas retorts.

Much valuable and interesting matter is to be found in the above mentioned contribution of Mr. Herring to the "Journal of Gas Lighting." He has had the opportunity of studying this problem in the light of the work done by the shale industry; and the system that the present writer has the honour of presenting for consideration to-day has many details in common with the shale retorts. Mr. Herring estimated the carbonizing wages—including all coke and coal handling in the retort-house and attention to producers—at 6d. per ton. In a later communication, he stated that this cost might be reduced to 3d. per ton, which was the figure in some of the shale vorks. Carbonizing wages have already been reduced to a low figure, and on most modern works using inclined retorts or machine stokers, come to something in the neighbourhood of 1d. per 1000 cubic feet. The writer thinks that with continuous carbonization the eventual cost for retort-house wages will be found in the neighbourhood of Mr. Herring's original estimate of 6d. per ton. At the Bourne Valley works, the wages come out at over 1d. per 1000 cubic feet; but the bulk of this is expended in wheeling out coke from the basement up a steep runway into the yard.

Life of Retorts.—With regard to the life of the retorts experience alone can decide; but there is every reason to imagine that it will be a long one. The retorts are strong in themselves, and are not subjected during working to changes of temperature or to rough treatment from rakes, charging scoops, &c. The contact of the sliding coke with the sides of the retorts tends to keep them free from carbon; but when this forms, as it does in the course of time on the top ten or fifteen feet of the retort, it can easily be removed with a light rod through the top mouthpiece cover.

The condition of the retorts can easily be inspected; and the only part of the retort highly heated, and so likely to require attention, can readily be reached through the top mouthpiece.

Cleanliness of Operation.—Now that local authorities are yearly issuing more stringent regulations with regard to smoke and nuisance generally, the question of cleanliness of operation is becoming one of increased importance, quite apart from the fact that most engineers like to see their works as clean and ship-shape as possible. With the introduction of high heats also, the attention required by pipes, mains, and governors has greatly increased, and on some works ascension pipes and hydraulic mains have become a perfect nightmare. With continuous carbonization the need of the hydraulic main disappears, and the ascension pipe, arch pipe, and dip pipe are replaced by a piece of pipe about 2 feet long. No doors are opened, so that all the smoke, dust, and dirt attendant on charging and drawing are done away with, and the top of the setting when working is as clean and comfortable as an ordinary retort-house floor would be when no operations are going on. As a consequence, the engineer can maintain a constant watch over the whole of the operations, without incurring the necessity of changing his clothes two or three times a day.

The conditions of labour are also much improved; a more intelligent class of man can be employed; and no particular physical strength is required. In saying that a more intelligent class of man can be employed, the writer is perhaps casting an unnecessary aspersion on the ordinary gas-works labourer. He has always taken men for the verticals straight from the yard, and has invariably found them take a keen and intelligent interest in the new work; and in the writer's opinion this goes to show it is the dull monotony of routine work that dulls many labourers; not natural apathy on their part.

No retort-house is required; a light roof over the coal hoppers will shelter any man engaged on the top of the retorts. The men attending to the bottom work are sheltered under the settings, and a simple protection such as light iron sheeting would be sufficient to protect the settings from wet and radiation. Of course, where there are existing retort-houses, it is quite a simple matter to place vertical retorts in them.

One of the chief advantages of continuous over intermittent working is the ease of control. In the best of settings the heats vary from time to time, and it is not an easy matter to alter the weight of the charges to accommodate them to the varying heats. With continuous working all that is necessary is to turn a nut, and the alteration of the amount of coal passing through the retort is instantly accomplished to meet the new conditions.

Heating.—Up to the present, every effort has been concentrated on overcoming the mechanical difficulties and in dealing with the conditions inside the retort. Comparatively little attention has been devoted to the settings, and the fuel results have not been good, averaging 19 per cent. by weight of the coal used when firing with wet coke, and 15 per cent. of the coal used when firing with dry coke. The phenomena of heating are, however, so well known now that no difficulty is anticipated on this score, and much improved fuel results are expected from the next settings.

Maintenance.—So far as maintenance is concerned, the writer thinks that the diagrams will indicate that this should be much less than when working machine stokers. The power required is also very small. At Bourne Valley, when working four settings of four retorts, the power necessary to drive the whole of the feed rolls, bottom pushers, and coke conveyors amounted to less than 5 H.P.

General Advantages.—The general advantages of continuous carbonization may be summarized as follows: (1) Increased make of gas. (2) Increased yield of tar. (3) Increased yield of ammonia. (4) The heat in the coke at present wasted is utilized in the production of water gas if desired. (5) The gas is free from naphthalene. (6) Coke relatively better is made from any class of coal. (7) The hydraulic main and ascension pipe, with all their attendant losses and disadvantages, are done away with. (8) Increased make of gas per retort. (9) Increased make of gas on same ground space. (10) No doors are opened; consequently all dust, smoke, and nuisance are done away with. (11) Improved labour conditions at reduced cost. (12) Great economy in housing. (13) Increased life of retorts. (14) Decreased maintenance charges. (15) Better control of the charge.

Several friends both at home and abroad have expressed the opinion that continuous carbonization is taking a very long time to become a practical accomplished fact. The

writer hopes that when consideration has been given to the history of the work undertaken, when the length of time required to obtain new fire-brick material and retorts in other than standard shapes, to make new patterns and obtain new castings, and the very heavy expenditure which is involved in making even the smallest experiment in retort working is considered, it will perhaps be felt that the ground covered has been sufficient to justify the time occupied.

Everyone will agree that Dr. Bueb is an authority on the subject of vertical retorts; and in this connection the writer would, in conclusion, quote from his address to the German Gas and Water Engineers in September, 1906. Alluding to continuous carbonization, he says:

> "Their English colleagues desired not merely to carbonize their coal in vertical retorts, but simultaneously to elaborate a continuous process. The path before them, however, was extraordinarily tedious and difficult. From many years' experience they at Dessau knew how almost always success in one direction was accompanied by failure in another. Nearly always when some device had been introduced which was an improvement in one respect, an undesired and unforeseen defect cropped up and had to be overcome. Six years' work with the vertical retort had thoroughly convinced them that only by orderly methods of progression could the problems that still awaited solution be solved efficiently."

The writer hopes that the present paper has demonstrated that the progress of continuous carbonization has been orderly; and so far as the efficiency of the solution of the problem is concerned, the results now presented must speak for themselves.

The following report, submitted to the Committee on Carbonization, by Dr. Harold G. Colman and Mr. A. E. Broadberry, was next presented:—

WORKING OF BUEB VERTICAL RETORTS.

To the Carbonization Committee of
the Institution of Gas Engineers.

GENTLEMEN,—In accordance with the instructions of the Committee, we have made an investigation of the working of the Bueb vertical retorts at the Dessau works of the Deutschen Continental Gas Gesellschaft, and have also inspected the working of the installations at the Mariendorf and Oberspree works of the Imperial Continental Gas Association at Berlin. We beg herewith to present our report, giving the results of the investigation.

We proceeded in the first instance to Dessau, arriving there on the evening of May 17. There we were joined by Mr. E. G. Hutchence, of the Imperial Continental Gas Association, Berlin, who had been kindly sent by Herr E. Körting to render assistance in arranging for the carrying out of the necessary tests. On the following day, May 18, we visited the Dessau Gas-Works, and, in the absence of Dr. Bueb, were received by the Engineer, Herr Reister, the Chemical Staff, and Herr Nowitsky, Works Manager.

After a general inspection of the plant, it was found on discussion that there were insuperable difficulties in the way of making a proper test of the plant at once. Two settings only of vertical retorts were at work. The first setting contained five retorts of more than double the normal size, the working of which is still in an experimental stage, and is not yet available for testing purposes. The second setting was one containing ten 4-metre retorts of the usual size; this being the installation which we were instructed to test. At that time, however, some of the retorts were out of action for scurfing purposes; and, moreover, it was also necessary to allow some of these to stand, as, owing to the low consumption of gas at the time, the holders were nearly full. Eventually it was decided to postpone the test for four days, to enable the scurfing to be completed, and to get down the stock of gas, and to have everything ready for starting the test on the morning of May 22.

As there was no possibility of doing any work at Dessau in the meanwhile, we communicated with Herr Körting in Berlin to see if it would be convenient for us to go there and visit the Mariendorf and Oberspree works before, instead of after, making the tests at Dessau; and to this suggestion he kindly agreed. We therefore proceeded to Berlin, and spent May 19 and 20 in an inspection of the 5-metre retorts at the above-named works. We were received by Herr Körting, who did everything in his power to render our visit as instructive and pleasant as possible.

At Mariendorf, the whole of the vertical retort installation at the time of our visit was in the hands of the staff of the Karlsruhe Versuchsanstalt of the German Gas Association, under the leadership of Dr. Bunte, junr.; Dr. Bunte, senr., being engaged simultaneously on a similar investigation of the 4-metre retorts at Zurich.

Dr. Bunte very kindly explained to us all the details of the tests arranged by the Versuchsanstalt, which were of a most complete nature, and fully adapted to obtain an accurate record of the weights of coal used, and of coke produced, as well as of the quantity and quality of gas produced. All weighing machines, meters, and instruments used had been previously verified either by the staff of the Versuchsanstalt themselves or by the Reichsanstalt.

Under these circumstances, it was not possible for us to make any regular series of tests, nor, indeed, did this seem desirable, as any tests we could have carried out would have been few compared with those being made by the staff of the Versuchsanstalt. Dr. Bunte, however, kindly allowed us to join with his staff in making one or two tests of the illuminating and calorific power of the gas.

In view of the great interest attaching to the results obtained at Berlin and Zurich under such good conditions, we asked Dr. Bunte if he thought his father would be willing to supply the Carbonization Committee with a copy of the results as soon as they were completed, on the understanding, of course, that they should not publish anything relating to these figures until the report had been published in Germany. Dr. Bunte thought his father would be quite willing to fall in with the suggestion, and promised to write him in the matter. Herr Körting likewise undertook to write supporting the request; and we have since heard from the latter that Dr. Bunte, senr., will send a copy of the report on receipt of an official request for it from the Institution. Any discussion of the actual results at Mariendorf will therefore be postponed until this report is to hand.

At the Oberspree works, the installation is of the same general character as at Mariendorf; but the total number of retorts is much smaller. The method of working is also similar; the carbonizing period being twelve hours, during the last two hours of which the retorts are freely steamed. A mixture of Durham coals was being carbonized at these works, whereas at Mariendorf, during the official test, Silesian coal was being used. The coke obtained at Oberspree was of excellent quality; and the tar produced was more nearly of the consistency of oil-gas tar than of the coal-tar made from similar coals in horizontal or inclined retorts.

Only two settings, each containing twelve retorts, were at work; and it was interesting to note that the entire work in the house, with the exception of the generator clinkering, was done by one man per shift, who carried out both the discharging and charging of the retorts, and the filling of the generator.

INVESTIGATION OF FOUR-METRE RETORTS AT DESSAU.

Returning to Dessau from Berlin on May 21, we found that all the arrangements for our test had been completed, and commenced a three days' test of the plant on May 22, at 8 a.m.

Method of Testing.

As already mentioned, two settings of retorts were at work—(1) the large retorts, five in the setting, and (2) the small retorts, ten in the setting; the latter being the type to be investigated. Separate coal-bunkers were provided for each bed; and these were completely emptied previous to commencing the test at 8 a.m. on May 22. The coal was weighed in separately to each set of bunkers over an automatic weighing-machine which had been recently adjusted; and at the end of the test at 7.30 a.m. on May 25, the coal remaining in the bunkers was weighed. In this manner, the coal actually carbonized could be calculated.

The gas made in each setting was conducted through separate condensers, scrubbers, purifiers, and meters; but unfortunately it was not possible to conduct the two streams into separate holders, and thus test either for illuminating and calorific power, as the two streams mixed at the outlet of their respective meters, and then travelled together to the holders. In order, therefore, to make tests of the quality of the gas, a 1-inch service-pipe had to be utilized, which was run from the outlet of the meter connected with the small retorts to the laboratory some 330 feet away, where samples of gas were slowly collected in a small test-holder of about

11 cubic feet capacity, which were tested for illuminating and calorific power.

Such collected samples, taken in a small holder, and off a small service-pipe of such length, are not satisfactory, especially as regards the illuminating power results obtained; the figures under these conditions being almost always decidedly below the true value; and we have little doubt that this is the case in the present instance. It must therefore be borne in mind that, in all probability, the figures given below for the illuminating power do not do full justice to the installation. The figures for calorific power are much less affected by this method of collecting the sample; and these may, in our opinion, be taken as accurate.

The illuminating power was determined on an open-bar photometer, using the Hefner standard, the Lummer-Brodhun disc, and the Carpenter burner; the value of the Hefner being taken as 0·908 candle. The calorific power tests were made in a Junkers calorimeter.

Kind of Coal Used and Quantity Carbonized.

The coal carbonized throughout the test was unscreened New Pelton, portions of which were taken from the coal buggies after weighing and thoroughly mixed to obtain an average sample, a portion of which was sent to England, and will be analyzed on its arrival. The total quantity of coal carbonized in the small retorts from 8 a.m. on May 22, to 7.30 a.m. on May 25, amounted to 34·575 tons; the details as to coal used, both in large and small retorts, being given in Table I.

The hours of charging the retorts are given in Table II., from which it will be seen that the total number of small retorts charged was 73, the average weight of charge being 0·474 ton, or just under 9·5 cwt. On the first day (from 8 a.m. May 22 to 8 a.m. May 23), the carbonization period was 9·5 hours, from 8 a.m. to 10 p.m., and ten hours from 10 p.m. to 8 a.m.; no steam being used on the retorts. On the second day's test (from 8 a.m. May 23 to 9.30 p.m. May 24) steam was admitted into the retorts during the last hour of carbonization; the total duration of the period being continued at ten hours. The necessary steam was raised in a small boiler in the retort-house, working at a pressure of 25 lbs. per square inch, which was lowered by means of a reducing valve to 7·1 to 8·5 lbs. before the retorts; the steam being admitted into the latter through a disc in which a hole of 4 mm. (0·157 inch) diameter had been bored. We were informed that tests previously made had shown that the amount of steam actually passing through the disc was not very constant, but varied from about 4 to 6 kilograms per hour. In all 26 retorts were steamed for one hour; so that, taking an average figure of 6 kilos. of steam per hour, the total quantity of steam used would be about 186 kilos., or 409 lbs. This quantity of steam would, however, be nothing like all converted into water gas, as a good deal of it would pass through the retort undecomposed.

On the third day (from 9.30 a.m. May 24 to 7.30 a.m. May 25) no steam was added to the retorts; but the carbonization period was maintained at ten hours.

Volume and Quality of Gas Produced.

The hourly production of gas in cubic metres (uncorrected) is given in Table III., together with the corrected total volume for each day's working (in cubic feet). In Table IV. will be found the results of the tests made of illuminating power and calorific power on (*a*) the "make," (*b*) the samples collected in the small test holder, and (*c*) the gas collected for about ten hours on each day in one of the works holders. In the latter tests it must be remembered that this is the whole gas production, including that from the large retorts; being made up of 45 to 48 per cent. of gas from the small and 55 to 52 per cent. of gas from the large retorts.

A number of samples of the gas were collected in glass tubes and sealed, and brought back to England for complete analysis. The results of these are given in Table V.

In discussing the tables, it will be convenient, in the first place, to consider the average results obtained over the whole of the three days—working without steam for two days and with steam for one day—as these depend only on observed figures, and involve no suppositions as to the amount of coal carbonized on each day, which it was impossible to determine directly. These results are as foot of column 1.

Average Results of Three Days Working of Dessau Four-Metre Retorts, Steam admitted to Retorts on One Day Only.

Coal carbonized	34·575 tons
Gas made	394,520 cubic feet
Gas made per ton	11,410 "
Average illuminating power of collected samples	16·10 candles
Average calorific power of collected samples	602 B.Th.U. gross 540 B.Th.U. net

(All figures corrected to 60° Fahr. and 30 inches barometer.)

Results Obtained Working Without Steam and with Steam in Retorts.

The exact computation of the make of gas per ton of coal with or without the use of steam is a matter of some little difficulty, owing to the impossibility of directly determining the amount of coal carbonized in each period. It was not found practicable to empty the coal-bunkers at the beginning and end of each period; but it was hoped that a fairly close estimate of the proportional quantities carbonized would be given by taking the number of retorts charged under each system of working, and multiplying this figure by the average weight of charge. Owing, however, to the somewhat irregular intervals at which the charging was carried out (owing to one bed of retorts only being at work), and possibly also to variation in the weight of the various charges, it was found to be out of the question to dissect the coal figures in this manner; and other methods had to be adopted.

It was manifest to us while steam was in use that only a small proportion of water gas was being made, as the average hourly make was barely 5 per cent. higher than when no steam was used, and the tests of illuminating power and calorific power on the "make" differed but little from those of the previous day when working without steam. This was confirmed by the analysis of the "average" gas samples taken under the two methods of working (Table V.); the average percentage of carbonic oxide being only raised by the use of steam from 5·72 to 6·87 per cent. Assuming that the water gas produced contained 40 per cent. of carbonic oxide, it follows from these figures that the amount of water gas added during the steaming period would be about 3·6 per cent. The total quantity of gas made while steam was in use amounted to 145,570 cubic feet; and on this basis the amount of water gas made was 5240 cubic feet. The total quantity of gas made on the three days was 394,520 cubic feet; and deducting from this the above 5240 cubic feet of water gas, we obtain a total coal gas make for the three days of 389,280 cubic feet. Based upon these calculations, the results obtained with and without the use of steam are given in the following table:—

Results of Carbonization of New Pelton Coal in Dessau Four-Metre Vertical Retorts, With and Without the Use of Steam.

	Yield of Gas at 60° Fahr. and 30 inches Barometer.		Illuminating Power of Average Samples, Carpenter Burner.	Calorific Power of Average Samples.	
	Per Ton.	Per Retort per Day.		B.Th.U. Gross.	B.Th.U. Net.
Without steam	11,259	13,072	16·45	604	543
With steam	11,680	13,560	15·37	596	535

Composition of the Gas.

From the analysis of the gas samples given in Table V., it will be noticed that in the case of all those taken either from the collected samples in the test holder or from the gas collected in No. 3 holder (the latter containing also the gas from the large retorts), the composition is fairly uniform. The percentage of carbonic acid is usually about 1 per cent., and that of the unsaturated hydrocarbons about 3 per cent. In all cases the percentage of nitrogen was directly determined, and not simply taken as the difference figure required to make the analysis add up to 100; the method of determination adopted being to burn 100 c.c. of the gas by means of hot copper oxide, removing the carbonic acid formed by means of caustic potash, and measuring the residual nitrogen. The low percentages of this constituent found in all cases is very noteworthy; the amount being very much less than is usually found in the gas obtained from horizontal or inclined retorts where makes of 11,000 cubic feet and more per ton are obtained. These figures show that the gas yield from the vertical retorts is not being swelled by producer or waste gas accidentally drawn in from the setting. The amount of nitrogen actually found (2·1 to 3·7 per cent.) is probably mostly derived from the usual small proportion of air inevitably drawn in on the vacuum side of the exhauster, as

although no air was purposely added to the gas during the tests for revivification purposes, the gas samples all contained from 0·2 to 0·4 per cent. of oxygen.

One analysis of the "make" is given in Table V. This was specially collected at a time when the quality was very good; the illuminating power being 20·34 candles and the calorific power 660 B.Th.U. The analysis shows that the high results were due to the fact that the percentage of unsaturated hydrocarbons and methane had risen considerably, while that of hydrogen had fallen.

On May 23 a determination of the total sulphur in the purified gas was made; the amount found being 21·7 grains per 100 cubic feet.

Coke Produced and Used for Heating Settings.

The coke produced was much larger and harder than that obtained from similar coal in horizontal and inclined retorts; and the percentage of breeze, even after passing the ordeal of the conveyor, was so small that it was insufficient in quantity to supply all that was required for placing in the retorts over the bottom lid before adding the charge of fresh coal—this breeze being added to prevent coal reaching the cold portion just above the lid. The breeze thus added becomes saturated with the tar draining from the coal above during the earlier period of carbonization, but is finally again completely carbonized. On discharging the coke, this breeze is found to have aggregated into large lumps. These are, however, less hard than the coke obtained from the freshly charged coal.

In the period of three days over which the test extended, it was impossible to obtain any reliable figures as to the total weight of coke produced, or of the amount of coke used for heating the settings. An attempt was made to get some idea of the latter; the generators being filled with coke previous to commencing the test and just before its completion, and the coke charged between the two periods being weighed in. It was found that 5·52 tons of moist coke was thus added. As the amount of coal used was 34·575 tons, the coke employed as fuel amounted to about 3·25 cwt. per ton of coal carbonized, or 16·25 per cent. It must also be remembered that at the time of the test only one setting was at work, which would tend to make the fuel consumption high.

Formation of Carbon and Thick Tar.

Carbon accumulates slowly on the walls of the retorts, as in the horizontal and inclined retorts; and its removal has to be carried out every four to six weeks. The vertical position of the retort enables this to be done very readily. By leaving the top and bottom lids open to just such an extent that the retort temperature is maintained at the normal, after about twelve hours the carbon is loosened so much that it is readily detached without injury to the retort.

The pipe corresponding to the ascension-pipe, which in these retorts is horizontal, requires cleaning once a week; the deposit in it being of a pitchy nature, and quite soft when warm. Only small quantities of free carbon are carried forward in the hot crude gas leaving the retorts. At first these gave some trouble, as they settled from the thin tar in the hydraulic main under the dip-pipe, forming heaps which then came away in lumps, and caused stoppages of the run-off pipes. This trouble has been entirely obviated by placing under each dip-pipe a tray, which is removed and emptied once a week.

Tar, Ammonia, and Cyanogen.

As with the coke, the period of the test was too short for us to make any determination of the amount of these bye-products. The Dessau representatives of the Company gave the following as the average figures:—

Tar, 4·8 to 5·2 kilos., of sp. gr. 1·1 per 100 kilos. of coal
Ammonia, 0·3 kilo. per 100 kilos. of coal
Cyanogen, 4 grammes $K_4FeCy_6.3H_2O$ per cubic metre of gas

Converting these into the usual English equivalents, they become—

Tar, 9·8 to 10·2 gallons per ton
Ammonia, 26·1 lbs. of sulphate per ton
Cyanogen, 2·87 lbs. $Na_4FeCy_6.10H_2O$ per 10,000 cubic feet

Samples of the tar and liquor were taken and sent to England, together with those of the coal and coke; but they have not yet arrived. These will be examined as soon as they are to hand.

CONSTRUCTION, HEATING, AND WORKING CONDITIONS.

Turning from the important results above described in regard to the make per ton, the quality, the constitution, &c., of the gas obtained at Dessau, a few notes as to the construction, heating, and working conditions must be added to make the report complete.

It should be premised that there is an essential difference between the English system and the German system of verticals; for whereas in England all recent attempts have been devoted to the ideal of continuous carbonization, our Continental friends content themselves for the time being with charging the retorts quite full, and leaving the charge in for a sufficient time to complete the process of carbonization of the mass. The coke thus formed, of a quality nearly equal to that of an ordinary coke-oven, is then completely discharged by an easy and inexpensively worked arrangement, and the retort refilled with another complete charge. They thus gain in economy of labour and in the quality of coke; while the gas produced compares about equally with ordinary horizontal working, notwithstanding the disadvantage of heavy pressure in the bottom of the retort in the early part of the charge, due to the rapid evolution of the gas throughout the entire depth having to force its way up through the whole mass to the off-take pipe at the top. In the English systems of continuous working, this disadvantage practically does not exist; and, in consequence of this absence of pressure, a larger yield of gas per ton of coal of approximately constant quality may be expected, while in addition each retort can deal with more coal per day than by the Dessau system.

At Dessau the retorts are set ten in a setting in two rows of five retorts. The height of the retorts is 4 metres (13 ft. 1½ in.), with the bottom or discharging mouthpiece placed 2½ metres (8 ft. 2½ in.) clear of the floor. The section of the retorts may be described as oblong, with corners rounded; while in size they are made taper, with the smaller end at the top and the larger at the bottom. The dimensions are: At the top, 570 mm. by 230 mm. (22½ in. by 9 in.); and at the bottom, 690 mm. by 350 mm. (27¼ in. by 13¾ in.). The total width of the bench is 5·2 metres (17 ft. 0¾ in.). One half of the width is occupied by the retorts, and the other half by the generator and regenerators, which extend the whole height of 6½ metres (21 ft. 4 in.). From centre to centre of the division walls, the Dessau settings are about 14 ft. 1 in.

In Berlin (at Mariendorf and Oberspree), the retorts are twelve in a setting, 5 metres high, making the total height of the bench and generator about 24 ft. 7½ in.; and the centre-to-centre measurement between the division walls is about 16 ft. 6 in. The average charge is 9½ cwt. per retort at Dessau, and 11½ cwt. at Berlin. These charges take about nine to ten hours to burn off; and at Berlin an extra two hours are allowed for steaming, and the daily capacity therefore is approximately the same as ordinary through horizontals. The great depth of the generators renders them efficient for long periods, and consequently fuel need only be added at periods of about twelve hours. The outlet for the generator gases is barely half-way up the generator; and the upper portion therefore acts simply as a feeding chamber in which the coke gets dried before reaching the combustion zone. Clinkering is usually performed every 48 hours; and in order to keep the spear-bars cool, and thus enable them to support the great weight of fuel, they are made hollow (2-inch barrel) and a stream of water flows through them and runs out from a ½-inch barrel core which extends nearly the whole length.

The bottom lids of the retorts are tightened by two powerful eccentrics, operated by a hand-lever socketed at the end to fit on to each stump-lever of the individual eccentrics. All the operating is done (apart from slackening and tightening the eccentrics and moving the coke-shoots) from the outside of the bench; the catches of the cross-bars of the bottom lids being attached to spindles running to the outside, where a lever thus arranged in connection with each catch is within easy reach of the operator. The lids themselves are hinged; and each or any one at will can be connected by a dog-clutch to a winch-handle placed centrally for opening and closing them all in turn. This is done by a neat arrangement of rack-and-pinion put in or out of gear by a sliding feather shaft. A weight is arranged to counterbalance each lid when in gear, so as to make the opening and closing a work of little exertion. So quick and simple is the performance of the charging and

discharging, that on the occasion of the Committee's visit to Mariendorf, 24 retorts were discharged and refilled with 12 cwt. of coal each by two men (one discharging and one charging) and the floors swept up in twenty minutes.

At Dessau, the hot-coke conveyor is situated directly under the discharge-doors of the retorts; and the coke is guided and regulated into it by a sloping shoot. This arrangement, however, is not ideal; being under the retorts, it is somewhat cramped and awkward of access. A much better arrangement exists at the Berlin works, where the coke conveyor is outside the bench, and the sloping shoot guides and regulates the discharging coke at right angles into the conveyor.

In each case the conveyor is covered by a series of flaps, and only the one necessary is open each time; thus shielding the house from radiant heat from the hot coke. The rapidity of operation ensures a very short period of running of the hot-coke conveyor. This is a very important matter as regards the expensive item of wear and tear.

The heating of the retorts is very regular; and owing to the producer portion of the generator being always full, the producer gas is practically constant in quality. The settings are therefore subject to very slight variations of heat, apart from those produced by the coal charges and by the admission of steam. The life of the setting is therefore likely to be considerably prolonged. Repairs to retorts are chiefly required at the bottom, where the greatest heat is maintained; and these are easily effected by cutting away and bricking up after (say) eighteen months or two years.

A very noticeable feature is the comparative coolness and comfort of the retort-house, even when the charging and discharging are in progress. The hot coke is enclosed as already stated; and the heat from the retorts ascends to the roof, where efficient ventilation takes it clear away.

As regards cost of construction, it is difficult to make any definite statement; but the cost should not exceed that of a completely equipped mechanically operated installation of the same capacity. For although the bench itself may cost quite as much, the roofing and part of the walls may be carried by the buckstays, and generally the cost of the house is materially reduced, while expensive machinery is almost entirely absent.

The advantages of the system may thus be briefly stated:—

- The low labour charges.
- The low cost of repairs, both as regards the retorts themselves and their very simple mechanical equipment.
- The high quality and superior density of the coke and the almost entire absence of breeze.
- The satisfactory average yield, the purity, and the lighting and heating value of the gas.
- The increased yield of ammonia.
- The thinness of the tar and avoidance of retort-house troubles resulting therefrom.

The chief drawback appears to be the heavy pressure of gas at the bottom of the retorts during the early stages of the charge—sometimes amounting to 8 inches. If this difficulty can be overcome, a higher yield of gas per ton may be effected. Herr E. Körting has made an attempt to overcome the trouble, and has met with an encouraging amount of success. His system is to separate the small coal and the large nuts and store them on opposite sides of the coal-bunkers, which have a dividing plate for this purpose. They are similarly kept separate in the charging measure, and pour into each side of each individual retort in a distinctly divided stream. The open formation of the column of nuts thus offers a freer passage for the gas. This system does not entirely prevent the trouble, but it certainly considerably reduces it. Notwithstanding this pressure difficulty, the fact remains that the production compares fairly with the best horizontal working.

The thanks of the Committee are due to Herr Körting, Mr. A. F. P. Hayman, and Herr E. G. Hutchence at Berlin, and to Herr Reister, Herr Nowitzky, and the chemical staff at Dessau, for their great courtesy in placing every facility at their disposal for these investigations; and their help is gratefully acknowledged.

(Signed) A. E. Broadberry.
Harold G. Colman.

London, June 6, 1908.

Addendum to the Report on Dessau Vertical Retorts.

Analysis of Coal Used in Tests and of Samples of Tar and Liquor obtained from these Retorts, and of Deposit in Take-Off Pipe from Retorts.

Analysis of Coal Used.

An average sample of the New Pelton coal employed in the tests was collected from the buggies as weighed, and gave the following figures on analysis:—

	Per Cent.
Free moisture	1·5
Volatile matter (excluding free moisture)	28·4
Ash	10·2

Analysis of Deposit in Take-Off Pipe from Retorts.

A sample of the deposit in the take-off pipes from the retorts at the Oberspree works was taken, and a determination made of the amount of matter soluble in benzene, the amount of residue ("free carbon"), and the volatile matter lost on ignition in the absence of air. For the sake of comparison, the figures are given which were obtained in a similar way with a sample of deposit from the ascension-pipe of a horizontal retort in which Durham coals were being carbonized at high temperatures:—

	Vertical Retort. Per Cent.		Horizontal Retort. Per Cent.
Soluble in benzene	51·1	..	6·4
"Free carbon"	48·9	..	93·6
Volatile matter by ignition	53·7	..	10·8

Analysis of Tar Samples.

The samples of tar were taken from the vertical retorts—one at Dessau and the other at Oberspree. The former is an average sample from the well, and is all derived from English coals, while the latter is a sample containing only the tar separated in the hydraulic main and condenser, and does not include the tar separated in the washer. Had this been included, the percentages of lower boiling constituents would have been somewhat increased. For comparison, an analysis is given of a sample of tar made from Durham coals at high heats in horizontal retorts.

The figures given for the percentages of oils of different boiling-point are the result of a single distillation only, and do not give the exact quantities of such oils present. But each distillation was made in the same apparatus, and under as nearly as possible the same conditions; and the results give a good indication of the comparative, although not the absolute, composition of the tar.

	Dessau Verticals. Per Cent. by Volume.		Oberspree Verticals. Per Cent. by Volume.		Horizontals. Per Cent. by Volume.
Ammoniacal liquor	0·9	..	1·3	..	12·3
	Per Cent. by Weight.		Per Cent. by Weight.		Per Cent. by Weight.
Dry tar—					
Boiling below 170°	1·7	..	2·3	..	1·1
,, from 170° to 270°	21·9	..	16·5	..	13·1
,, ,, 270° to 350°	21·6	..	20·8	..	13·2
,, above 350°	54·3	..	60·0	..	72·1
Naphthalene	3·6	..	3·6	..	9·0
"Free carbon"	0·4	..	0·6	..	28·7
Specific gravity	1·10	..	1·13	..	1·25

Especially noticeable are the small percentages of naphthalene in the tar from the vertical retorts, and the still smaller amounts of "free carbon."

Ammoniacal Liquor.

Average samples of the liquor were taken from the wells at Dessau and Oberspree, and the amount of volatile and fixed ammonia and of ammonium sulphocyanide determined.

	Dessau Verticals. Per Cent.		Oberspree Verticals. Per Cent.
Volatile ammonia	1·31 (6·03 oz.)	..	1·67 (7·71 oz.)
Fixed ammonia	0·26 (1·20 ,,)	..	0·23 (1·06 ,,)
Ammonium sulphocyanide	0·13	..	0·11

The samples are of somewhat low strength, probably owing to its being the period of minimum make at both works. Even allowing for this, the amount of ammonium sulphocyanide present is very much less than with horizontal or inclined retorts, the liquor from which, when of 10-oz. strength, usually contains from 0·3 to 0·7 per cent. of ammonium sulphocyanide. This fact is not unimportant where trouble is experienced in getting rid of the waste liquor from the ammonium stills, the sulphocyanide in which is one of the most objectionable constituents.

HAVE YOU SEEN THE

DESSAU PATENT VERTICAL RETORT WHICH EFFECTS A REVOLUTION IN CARBONIZING

The Advantages claimed are—

It is Worked with Ease and without Discomfort.

It Produces a Maximum Yield of Gas for a Minimum of Labour Cost.

No Stopped Pipes.

No Naphthalene.

Reduction of Sulphur Compounds.

Good Tar.

Increased Yield of Ammonia.

Saving of Ground-Space and Cost of Retort-House.

This System has been for some time in use at the following Places:—

	Number of Retorts.		Number of Retorts.
Barcelona	150	Hamburg—Grasbrook	50
Cologne	240	Aschaffenburg	8
Dortmund	100	Halle a/d.S.	60
Duisburg	50	Dessau	60
Sölingen	30	Potsdam	48
Ludwigshafen	30	Berlin—Oberspree	48
Zürich	100	Berlin—Mariendorf	84
Düsseldorf	70	Berlin—Tegel	10

Other Installations are in course of construction as under:—

	Number of Retorts.		Number of Retorts.
Offenbach	80	Chemnitz	60
Brandenburg a/H.	60	Worms	30
Trieste	20	Potsdam (Repeat Order)	40
Elberfeld	120	Mariendorf (Repeat Order)	72
Frankfort—Bockenheim	120	Charlottenburg	70
Genoa	60	City of Berlin—Danzigerstrasse	240
Magdeburg	80	City of Berlin—Schmargendorf	80

The Dessau Vertical Retort Company (25, Schöneberger Ufer, Berlin, W.35) are now prepared to arrange for Installations of their System in the United Kingdom and Colonies.

For Terms and Particulars apply to the

DESSAU VERTICAL RETORT COMPANY,

c/o Mr. CHARLES HUNT, Consulting Engineer,

17, VICTORIA STREET, WESTMINSTER, S.W.

The "CAP-IT-AL"
INVERTED GAS BURNER.

With Green or White Enamelled Casing with Gold Lines.

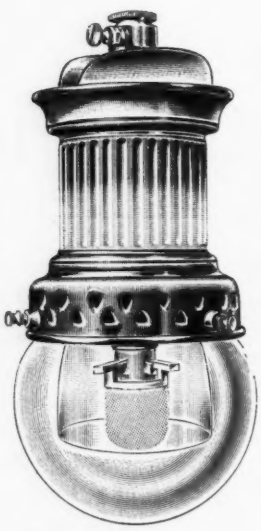
IT WILL NOT TARNISH.

BEST POSSIBLE RESULTS UNDER ANY PRESSURE.

No. 10971. Green Enamelled Burner, with 10861 Opal Cut Star Globe,
8s. 6d. each.
No. 10972. White Enamelled ditto,
8s. 6d. each.
Byepass 2s. 4d. extra.

No. 10973. Green Enamelled Burner, complete with 10859 Reseda Tinted Mano Globe.
7s. 2d. each.
No. 10974. White Enamelled ditto,
7s. 2d. each.
No. 10975. Green Enamelled Burner, with Ruby Tinted Mano Globe, 10860,
7s. 2d. each.
No. 10976. White Enamelled ditto,
7s. 2d. each.
Byepass 2s. 4d. extra.

THE PRICES SHOWN ARE SUBJECT TO USUAL TRADE DISCOUNT.



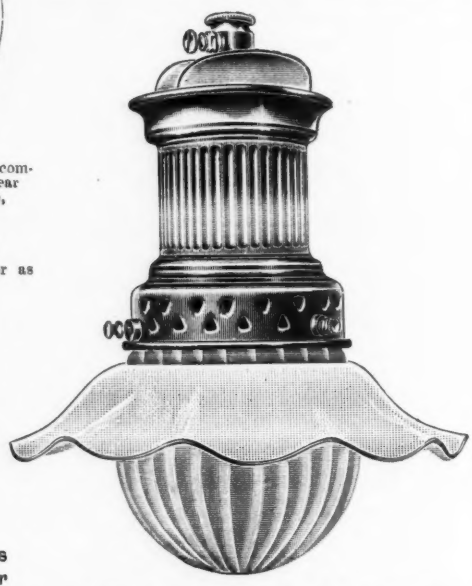
No. 10723. Green Enamelled Burner, complete as shown, with Opal Globe, Clear Inner Glass and "Glasmi" Mantle,
6s. 6d. each.
No. 10724. Ditto with Byepass,
8s. 10d. each.
No. 10725. White Enamelled Burner as 10723,
6s. 6d. each.
No. 10726. Ditto with Byepass,
8s. 10d. each.

No. 10977. Green Enamelled Burner, with 10876 Flint Etched Shade and 10104 Clear Bulb,
8s. each.
No. 10978. White Enamelled ditto,
8s. each.
No. 10979. Green Enamelled do., with 10875 Ruby Etched Shade and 10104 Clear Bulb,
8s. 4d. each.
No. 10980. White Enamelled ditto,
8s. 4d. each.
Byepass 2s. 4d. extra.

These Burners can be guaranteed for giving satisfaction and developing business.

There are hundreds of places where the "Capital" Burner can be used to advantage, but it is designed more particularly for Residential Illumination.

Latest Lists and Prices gladly sent upon request.



No. 10969. Green Enamelled Burner, with 10874 Clear Optic Globe and 10110 Opal Shade,
7s. 2d. each.
No. 10970. White Enamelled ditto,
7s. 2d. each.
Byepass 2s. 4d. extra.

J. & W. B. SMITH, 17 to 23, Farringdon Road, LONDON, E.C.

TABLE I.—*Coal Carbonized in Small Retorts from May 22 (8 a.m.) to May 25 (7.30 a.m.), 1908.*

Coal weighed into bunkers		36,088 kilos.
Left in bunkers	895 kilos.	
Taken for samples	53 ,,	
		948 ,,
Total coal carbonized		35,140 kilos. = 34·575 tons.

TABLE II.—*Times Charging Small Retorts, May 22 to 25, 1908.*

Date.	Hour.	Retorts Charged.	Steam On.
May 22	8 a.m.	2, 4, 8	..
,, ,,	10 ,,	1, 10	..
,, ,,	12 noon	3, 6	..
,, ,,	1 p.m.	5, 7, 9	..
,, ,,	5.30 ,,	2, 4, 8	..
,, ,,	7.30 ,,	1, 10	..
,, ,,	9.30 ,,	3, 6	..
,, ,,	11 ,,	5, 7, 9	..
,, 23	3.30 a.m.	2, 4, 8	..
,, ,,	5.30 ,,	1, 10	..
,, ,,	7.30 ,,	3, 6	..
,, 23	9 a.m.	5, 7, 9	8 a.m. to 9 a.m. on 5, 7, 9
,, ,,	1.30 p.m.	2, 4, 8	12.30 to 1.30 p.m. on 2, 4, 8
,, ,,	3.30 ,,	1, 10	2.30 p.m. to 3.30 p.m. on 1, 10
,, ,,	5.30 ,,	3, 6	4.30 to 5.30 p.m. on 3, 6
,, ,,	7 ,,	5, 7, 9	6 to 7 p.m. on 5, 7, 9
,, ,,	11.30 ,,	2, 4, 8	10.30 to 11.30 p.m. on 2, 4, 8
,, 24	1.30 a.m.	1, 10	12.30 to 1.30 a.m. on 1, 10
,, ,,	3.30 ,,	3, 6	2.30 to 3.30 a.m. on 3, 6
,, ,,	5 ,,	5, 7, 9	4 to 5 a.m. on 5, 7, 9
,, 24	9.30 a.m.	2, 4, 8	8.30 to 9.30 a.m. on 2. 4, 8*
,, ,,	11.30 ,,	1, 10	..
,, ,,	1.30 p.m.	3, 6	..
,, ,,	3 ,,	5, 7, 9	..
,, ,,	7.30 ,,	2, 4, 8	..
,, ,,	9.30 ,,	1, 10	..
,, ,,	11.30 ,,	3, 6	..
,, 25	1 a.m.	5, 7, 9	..
,, ,,	5.30 ,,	2, 4, 8	..

* Gas made by this steam included in previous test of gas made, which was taken to 9.30 a.m. instead of 8 a.m. on this account.

TABLE III.—*Hourly Make of Gas (Uncorrected) on Small Retorts.*

First Day, Without Steam.			Second Day, Without Steam.			Third Day, Without Steam.		
Date.	Hour.	Make of Gas. Cub. Met.	Date.	Hour.	Make of Gas. Cub. Met.	Date.	Hour.	Make of Gas. Cub. Met.
May 22	8 a.m.	..	May 23	8 a.m.	..	May 24	9.30 a.m.	..
,, ,,	9 ,,	190	,, ,,	9 ,,	180	,, ,,	10 ,,	80
,, ,,	10 ,,	170	,, ,,	10 ,,	170	,, ,,	11 ,,	160
,, ,,	11 ,,	160	,, ,,	11 ,,	160	,, ,,	12 noon	150
,, ,,	12 noon	170	,, ,,	12 noon	170	,, ,,	1 p.m.	150
,, ,,	1 p.m.	170	,, ,,	1 p.m.	170	,, ,,	2 ,,	160
,, ,,	2 ,,	170	,, ,,	2 ,,	160	,, ,,	3 ,,	140
,, ,,	3 ,,	170	,, ,,	3 ,,	170	,, ,,	4 ,,	150
,, ,,	4 ,,	170	,, ,,	4 ,,	170	,, ,,	5 ,,	160
,, ,,	5 ,,	170	,, ,,	5 ,,	170	,, ,,	6 ,,	150
,, ,,	6 ,,	160	,, ,,	6 ,,	160	,, ,,	7 ,,	150
,, ,,	7 ,,	170	,, ,,	7 ,,	180	,, ,,	8 ,,	150
,, ,,	8 ,,	160	,, ,,	8 ,,	160	,, ,,	9 ,,	150
,, ,,	9 ,,	169	,, ,,	9 ,,	160	,, ,,	10 ,,	140
,, ,,	10 ,,	141	,, ,,	10 ,,	170	,, ,,	11 ,,	150
,, ,,	11 ,,	150	,, ,,	11 ,,	160	25	12 mid.	150
23	12 mid.	150	24	12 mid.	170	,,	1 a.m.	150
,,	1 a.m.	160	,,	1 a.m.	170	,,	2 ,,	170
,,	2 ,,	160	,,	2 ,,	150	,,	3 ,,	170
,,	3 ,,	150	,,	3 ,,	160	,,	4 ,,	180
,,	4 ,,	150	,,	4 ,,	150	,,	5 ,,	160
,,	5 ,,	160	,,	5 ,,	180	,,	6 ,,	170
,,	6 ,,	160	,,	6 ,,	180	,,	7 ,,	150
,,	7 ,,	150	,,	7 ,,	150	,,	7.30 ,,	80
,,	8 ,,	140	,,	8 ,,	170			
			,,	9 ,,	170			
			,,	9.30 ,,	80			
Tem. = 23° C. Bar. = 754 mm.		3870	Tem. = 20° C. Bar. = 757 mm.		4240	Tem. = 18·5° C. Bar. = 755 mm.		3420
Total gas made, corrected to 60° Fahr. and 30 inches bar.—130,690 cubic feet.			Total gas made, corrected to 60° Fahr. and 30 inches bar.—145,570 cubic feet.			Total gas made, corrected to 60° Fahr. and 30 inches bar.—118,260 cubic feet.		

TABLE IVA.—*Tests of Illuminating and Calorific Power, First Day, May 22 to 23, 1908 (8 a.m. to 8 a.m.).*

[No steam used.]

ILLUMINATING POWER.

"Make." Small Retorts only.		Gas Collected in Small Test Holder, Small Retorts only.		Gas Collected in No. 3 Holder, containing Gas from both Large and Small Retorts.	
Hour.	Candles.	Hour.	Candles.	Hour.	Candles.
11 a.m.	17·83	10 a.m. to 2 p.m.	17·40	10 a.m. to 6 p.m.	17·08
12·15 p.m.	16·18	2.45 p.m. ,, 6 ,,	16·38		
3·30 ,,	19·11	8 p.m. ,, 2 a.m.	15·43		
4·30 ,,	17·23				
5·30 ,,	15·87				
Average. . .	17·24	Average	16·40	Average	17·08

CALORIFIC POWER.

"Make." Small Retorts only.		Gas Collected in Small Test Holder, Small Retorts only.			Gas Collected in No. 3 Holder, containing Gas from both Large and Small Retorts.		
Hour.	B.Th.U. Gross.	Hour.	B.Th.U. Gross.	B.Th.U. Net.	Hour.	B.Th.U. Gross.	B.Th.U. Net.
10.30 a.m.	569	10 a.m. to 2 p.m.	597	541	10 a.m. to 6 p.m.	600	535
11.15 ,,	631	2.45 ,, 6 ,,	592	526			
12.25 p.m.	626	8 p.m. to 2 a.m.	599	537			
3.50 ,,	610						
4.20 ,,	599						
5.35 ,,	567						
Average. . .	600	Average	595	535	Average	600	535

TABLE IVB.—*Tests of Illuminating and Calorific Power, Second Day, May 23 to 24, 1908 (8 a.m. to 9.30 a.m.)*

[Each retort steamed one hour.]

ILLUMINATING POWER.

"Make." Small Retorts only.		Gas Collected in Small Test Holder, Small Retorts only.		Gas Collected in No. 3 Holder, containing Gas from both Large and Small Retorts.	
Hour.	Candles.	Hour.	Candles.	Hour.	Candles.
12.10 p.m.	17·98	10 a.m. to 2 p.m.	15·16	9.30 a.m. to 6 p.m.	17·72
3.20 p.m.	16·90	2.45 p.m. ,, 4.45 p.m.	14·61		
4.15 p.m.	17·94	8 p.m. ,, 2 a.m.	16·34		
Average. . .	17·61	Average	15·37	Average.	17·72

CALORIFIC POWER.

"Make." Small Retorts only.		Gas Collected in Small Test Holder, Small Retorts only.			Gas Collected in No. 3 Holder, containing Gas from both Large and Small Retorts.		
Hour.	B.Th.U. Gross.	Hour.	B.Th.U. Gross.	B.Th.U. Net.	Hour.	B.Th.U. Gross.	B.Th.U. Net.
10.15 a.m.	603	10 a.m. to 2 p.m.	590	531	9.30 a.m. to 6 p.m.	602	537
3.15 p.m.	600	2.45 p.m. ,, 4.45 p.m.	610	546			
4.20 p.m.	570	8 p.m. ,, 2 a.m.	587	527			
Average. . .	591	Average	595	535	Average	602	537

TABLE IVc.—*Tests of Illuminating and Calorific Power, Third Day, May 24 to 25, 1908 (9.30 a.m. to 7.30 a.m.).*

[No steam used.]

ILLUMINATING POWER.

"Make," Small Retorts only.		Gas Collected in Small Test Holder, Small Retorts only.		Gas Collected in No 3 Holder, Containing Gas from both Large and Small Retorts.	
Hour.	Candles.	Hour.	Candles.	Hour.	Candles.
11.45 a.m.	14·55	10.30 a.m. to 2 p.m.	16·40	9.30 a.m. to 6 p.m.	19·42
3.45 p.m.	20·34	2.45 p.m. ,, 5 45 p.m.	16·73		
5 p.m.	15·82	8 p.m. ,, 2 a.m.	16·41		
Average . .	16·90	Average	16·51	Average	19·42

CALORIFIC POWER.

"Make," Small Retorts only.		Gas Collected in Small Test Holder, Small Retorts only.			Gas Collected in No. 3 Holder, Containing Gas from both Large and Small Retorts.		
Hour.	B.Th U. Gross.	Hour.	B.Th.U. Gross.	B.Th.U. Net.	Hour.	B.Th.U. Gross.	B.Th.U. Net.
11 a.m.	606	10.30 a.m. to 2 p.m.	606	542	9.30 a.m. to 6 p.m.	630	564
3.50 p.m.	660	2.45 p.m. ,, 5.45 p.m.	634	571			
4.50 p.m.	630	8 p.m. ,, 2 a.m.	598	537			
5.30 p.m.	613						
Average . .	627	Average	613	550	Average	630	564

TABLE IVd.—*Average Results of Illuminating and Calorific Power Tests, for Three Days, May 22 to 25, 1908.*

[Retorts steamed on one day only].

ILLUMINATING POWER.

"Make," Small Retorts only.		Gas Collected in Small Test Holder, Small Retorts only.		Gas Collected in No. 3 Holder, Containing Gas from both Large and Small Retorts.	
Date.	Candles.	Date.	Candles.	Date.	Candles.
May 22	17·24	May 22	16·40	May 22	17·08
,, 23	17·61	,, 23	15·37	,, 23	17·72
,, 24	16 90	,, 24	16·51	,, 24	19·42
Average . .	17 25	Average	16·10	Average	18·11

CALORIFIC POWER.

"Make," Small Retorts only.		Gas Collected in Small Test Holder, Small Retorts only.			Gas Collected in No. 3 Holder, Containing Gas from Both Large and Small Retorts.		
Date.	B.Th.U. Gross.	Date.	B.Th.U. Gross.	B.Th.U. Net.	Date.	B.Th.U. Gross.	B.Th.U. Net.
May 22	600	May 22	596	535	May 22	600	533
,, 23	591	,, 23	596	535	,, 23	602	537
,, 24	627	,, 24	613	550	,, 24	630	564
Average . .	606	Average	602	540	Average	611	545

Complete Analysis of Gas Samples.

	"Make." Small Retorts Only.	Samples Collected in Test Holder. Small Retorts Only.							Samples from No. 3 Gasholder, containing Gas from Large and Small Retorts.		
	May 24, 4 p.m. No Steam Used.	May 22, 3-6 p.m. No Steam.	May 22-23, 8 p.m.- 2 a.m. No Steam.	May 23, 10 a.m.- 2 p.m. Steam On.	May 23, 2.45-4.45 p.m. Steam On.	May 23-24, 8 p.m.- 2 a.m. Steam On.	May 24, 10 a.m.- 2 p.m. No Steam.	May 24, 2.30-5.15 p.m. No Steam.	May 22, 10 a.m.- 6 p.m. No Steam.	May 23, 9.30 a.m.- 6 p.m. Steam On.	May 24, 9.30 a.m.- 6 p.m. No Steam.
Carbonic acid	1·0	0·6	0·8	1·0	1·0	1·0	1·0	1·0	1·0	1·2	1·0
Unsaturated ydrocarbons . .	3·6	2·9	2·9	3·0	2·9	3·0	2·8	3·0	3·0	2·8	3·1
Oxygen	0·4	0·3	0·2	0·2	0·3	0·4	0·2	0·3	0 3	0·3	0·2
Carbonic oxide	5·4	5·7	5·5	6·5	6·6	7·5	6·0	5·3	5·9	6·2	5·7
Methane	35·6	30·0	29·9	28·5	28·7	27·8	29·7	30·2	30·8	30·3	32·6
Hydrogen	51·2	56·4	57·5	57·9	57·4	57·7	57·6	58·0	55·2	56·2	54·5
Nitrogen	3·5	3·7	3·7	2·6	2·9	2·3	2·1	2·2	3·6	2·9	2 5
	100 7	99·6	100·5	99·7	99·8	99·7	99·4	100·0	99·8	99·9	99·6

Total Sulphur in Purified Gas.

A test on the "make" (made on May 23) gave 21·7 grains of sulphur per 100 cubic feet.

Discussion.

The PRESIDENT said the members had just received copies of the report of the Carbonization Committee, and he thought that it would be well for him to ask the two gentlemen who were responsible—Dr. Colman and Mr. Broadberry—to open the discussion.

Dr. COLMAN said, as the report giving the result of the visit of Mr. Broadberry and himself to Germany was in the hands of the members, he did not propose to go in detail into the matters they had dealt with, but would confine himself to one or two special points. Their tests were confined to the 4-metre retorts at Dessau, using New Pelton coal; but they also visited the Mariendorf and Oberspree works of the Imperial Continental Gas Association. At the time of their visit, the plant at Mariendorf consisted of 5-metre retorts, and was in the hands of the Research Committee of the German Gas Association, under the leadership of Dr. Bunte, who were making a complete series of tests of that plant, as well as at Zurich. Dr. Bunte, jun., who was

in charge of the investigation at Berlin, kindly showed them all the arrangements made for taking the tests, which were of the most complete nature, and calculated to ensure very accurate results. All the instruments, meters, and so forth had been previously verified, and every precaution was taken to ensure accuracy. In addition to this, Dr. Bunte, sen., had very kindly forwarded to the Carbonization Committee a copy of his report on the results obtained at the two places, with permission to refer to it at the present meeting. The report was to be presented by Dr. Bunte—possibly he was presenting it at that very moment—to the meeting of the German Association in Berlin. He (Dr. Colman) had put on the blackboard a summary of the more important results obtained at Dessau, at Mariendorf (where they were using Silesian coal), and at Zurich. The Mariendorf results had already been given by Mr. Hayman in his paper; but there were slight differences in the figures, owing to Mr. Hayman having only unchecked figures. But these had now been checked. The Dessau results were their own; while the Mariendorf and the Zurich results were those obtained by the German Gas Association.

Table showing Results obtained by Dr. Bunte.

[A. Make per ton, in cubic feet. B. Make per retort per day, in cubic feet. C. Illuminating power, in candles. D. Calorific power, in B.Th.U. E. Nitrogen in gas, per cent. F. Actual weight of coke, percentage on coal used.]

	Dessau 4-Metre Retort. New Pelton Coal.		Mariendorf 5-Metre Retort. Silesian Coal.		Zurich 4-Metre Retort. Saar Coal.	
	Without Steam.	With Gentle Steaming.	Without Steam.	With Copious Steaming.	Without Steam.	With Copious Steaming.
A . .	11,2,9	11,680	11,400	13,810	12,180	13,820
B . .	13,072	13,560	14,563	15,827	14,392	15,458
C . .	16·45	15·37	15·90	12·16	9·11	6·23
D . .	604	596	585	537	591	561
E . .	2·9	2·6	1·1	1·3	..	..
F . .	16·25		14·6	14·1	13·9	15·0

Comparing the figures with and without steam in the 4-metre retorts at Dessau, the 5-metre retorts at Mariendorf, and the 4-metre retorts at Zurich, the figures of the make per ton, illuminating power, and calorific power did not vary more than one would expect to be the case, seeing that different kinds of coal were carbonized at each place. The illuminating power was 16·45 candles with a Carpenter burner at Dessau; 15·90 candles with the same burner at Mariendorf; and at Zurich they tested with a flat-flame burner, so that one could not form a judgment about it. The calorific power was 604 B.Th.U. at Dessau, 585 B.Th.U. at Mariendorf, and 591 B.Th.U. at Zurich. Using steam, of course, the results were different. At Dessau a small quantity was used; but at Mariendorf steam was copiously employed; while at Zurich, with the 4-metre retorts, a fairly large quantity, but less than at Mariendorf, was used. As one would expect, the more steam that was employed, the higher was the make, with a corresponding reduction in the illuminating and the calorific powers. The figures for these, without steam, were very satisfactory; but it was more especially with regard to those giving the make of gas per ton that he should like to offer a few remarks. This make, which was about 11,300 cubic feet at Dessau, did not, at first sight, look very high when compared with the makes now obtained with horizontal and inclined retorts in this country. But he would call attention to the complete analysis of the samples of gas obtained at Dessau, as given at the end of the report. The most noticeable point was the very low percentage of nitrogen present, amounting to something less than 3 per cent. on the average at Dessau; while at Mariendorf there was a still lower average of 1·1 per cent. without steam, and 1·3 per cent. with steam. It followed that this make of 11,300 cubic feet was all derived from the coal; and it had not been supplemented by furnace gases drawn accidentally into the retort. In fact, with the Dessau vertical system this was almost impossible, owing to the pressures which existed in the retort throughout almost the whole period of carbonization. Before one could compare the makes per ton obtained with horizontals, it was absolutely essential with the make to give the average percentage of nitrogen contained in the gas; and this, in the great majority of cases, was very much higher than the 3 per cent. found at Dessau. Indeed, a common figure in such cases was 9 per cent.; and he would take this figure for comparison, as it enabled him to show what a difference the introduction of the extra 6 per cent. of nitrogen would make. In such a gas made from horizontal retorts, if this additional 6 per cent. of nitrogen was obtained from the furnace gases, it would be accompanied by a quarter of its volume of carbonic acid and a somewhat similar volume of steam, which would be partly converted by the red-hot coke into hydrogen and carbon monoxide, and increase the volume. So that the extra 6 per cent. of nitrogen thus drawn in would increase the volume by at least 8 per cent. If the make per ton, as actually obtained at Dessau, was increased by 8 per cent., as it could be by the injection of furnace gases to that extent, it would certainly be something like 12,200 cubic feet, which would be the figure to compare with gas made with horizontal retorts containing about 9 per cent. of nitrogen. The illuminating power of such a gas would be roughly about 14 candles, and the calorific power about 560 B.Th.U. Of course, the mixing of such a quantity of furnace gases deliberately with the gas produced by the carbonization of a ton of coal was not a thing which would be advisable; and it seemed to him that the plan that was adopted in connection with the vertical retorts, of diluting the gas with water gas, where a greater volume of lower quality was required, was far preferable. Whether the water gas was best produced by steam in the retort or by separate production in an outside plant, was simply a question of £ *s. d.*, which depended upon many considerations—in particular, on the local circumstances as to the cost of production of water gas and of the total quantity required. While the question of the quality and the quantity of the gas produced by carbonization was of primary importance, the value of the system did not depend wholly on these points, but on many other collateral matters. These had been ably dealt with by Mr. Hayman; and Mr. Broadberry would allude to them so far as they came under his observation. But one point he (Dr. Colman) should like to mention, and that was the proof afforded that in these retorts the gas as it was made was not subjected to over-heating to anything like the extent, if at all, that it was in horizontal or inclined retorts having a free space above the coal. This was clearly shown by the analysis given in the addendum to the report, as to the deposit formed in the take-off pipe (it was not an ascension-pipe), and the comparative analysis given of the deposit from the ascension-pipe with horizontal retorts in which Durham coal was being carbonized at a high temperature. There were also analyses of the tar from verticals and from horizontals; the most notable point being the almost entire absence of free carbon, of which they had just heard a great deal. It was very difficult to put a definite money value upon the avoidance of the formation of free carbon, with the resulting trouble in the ascension-pipe—such as stopped pipes, pitched mains, bad separation of ammoniacal liquor from the tar, and so on. But all would agree—more especially those carbonizing Durham coal—that the money value represented by preventing such troubles was very considerable. Speaking generally, there could be no doubt that all who saw this system in operation would be greatly struck with the ease and simplicity of working; and the members who were going to Berlin to see the retorts in actual work would, he believed, agree in giving to Dr. Bunte and those associated with him their hearty congratulations on the success achieved. This success was certainly not obtained easily and all at once, but only after conquering numerous difficulties, such as always cropped up when any new departure was made. Turning for a moment to Mr. Woodall's paper, he thought the members were all greatly indebted to him for the full information he had given as to the work which he and Mr. Duckham had been carrying on for the last five years, and especially for the full account he had given of the difficulties which had to be overcome, and which would make them realize more than they had ever done before how great and numerous these really were. They all congratulated Messrs. Woodall and Duckham on the measure of success they had already achieved; and they hoped they would go on and prosper. The figures obtained from the last installation of vertical retorts, as Mr. Woodall had pointed out, were not yet sufficiently extended for detailed discussion; but one point struck him (Dr. Colman) as differentiating between continuous carbonization and that which was carried on in intermittently charged retorts—viz., the greater production of gas in the same length of retort under the continuous system. The highest quantity per foot of retort on the intermittent system worked out to about 1100 cubic feet per day; whereas in

Messrs. Woodall and Duckham's last setting the average was something like 1445 cubic feet per foot per day. Of course, as the retort was longer—being 25 feet, compared with either 13 or 17 feet—its total production was very much larger.

Mr. A. E. Broadberry (Tottenham) said the opinions he and Dr. Colman had formed as to what they had seen in Germany would be found in the report, which he would leave the members to read, and he would simply make a few additional remarks. Dr. Colman had fully dealt with the results obtained, and he (Mr. Broadberry) need not repeat what had been stated; but there was plenty left for him to say with regard to the construction of the retort-settings and the facility with which they were worked. The present discussion was on the two papers before them. It would be noticed from them—even from their titles—that there was an essential difference between the vertical system as applied in Germany and that by which Mr. Woodall had been working. The title of his paper was "Continuous Carbonization in Vertical Retorts;" while the German system was the intermittent one. A question which he should like to hear dealt with further was this: What are the actual advantages of continuous carbonization? He could quite realize that the ideal to be worked for was to bring off the same quality of gas continuously coming from the retorts. This would be especially desirable at works operating with one retort only; but it did not appear to be so important in large works where there were many retorts in action, and where the work of one overlapped that of another, so that the average make of gas from the whole would be of a fairly uniform quality during the day. One of the advantages which Mr. Woodall claimed for continuous as compared with intermittent working (he did not know whether the author meant intermittent vertical or intermittent horizontal) was ease of control. But it seemed to him that with the German verticals it was quite easy to control the charges according to the heats. Mr. Woodall did it by turning a nut. In Germany, however, they burnt the charges right off, and did not even turn a nut; they just left the charge in for a little more or a little less time, according to the heat; and this seemed to be quite as easy as adjusting any nuts. In Germany, they did not even turn a nut. They just left the charge in a little longer, or less time according to the heat; and that seemed quite as easy as adjusting a nut. So far as they were able to see, the handling of the retorts was as easy as it was possible to conceive; and their friends on the Continent must be congratulated on the high state of efficiency to which they had brought the whole of their arrangements. Even the discharging arrangement, which Mr. Hayman had mentioned as being complicated, he (Mr. Broadberry) considered a very beautiful and simple piece of gearing when examined; and he did not see anything in it likely to get out of order. One of Mr. Woodall's claims was for the production of better coke; and he understood him to say that his coke bulked out to more than ordinary coke, so much so that a ton would fill 27 sacks, where ordinary coke would only fill about 20 sacks. This appeared to him to show that the coke was lighter and looser in character; and he did not quite see how that could improve it. He should have taken it that the dense coke, such as was obtained from the German retorts, which was almost suitable for metallurgical purposes, was the better kind. One or two persons to whom he had mentioned the results called attention to the fact that the quantity of fuel used was much higher with the vertical system than with the best horizontal working. The figures at Dessau appeared to be rather higher than they were at other places. But he thought that probably one thing which accounted very largely for the fuel being high appeared from the fact that the system was rather new, and that in most cases they introduced a lot of steam for the purpose of making water gas; and the manufacture of this gas must use up a certain amount of fuel. In addition to this, the cooling effect which the steam produced on the retort had to be made up for by additional fuel. Possibly it was having this matter in mind which induced Mr. Woodall to suggest that, where a large quantity of water gas was required, it would be better to make it in a separate vessel, and introduce it into the retort as water gas. He should like to emphasize the remark of Dr. Colman with regard to the make per ton. One or two friends had said that there was nothing very extraordinary about a make of 11,259 cubic feet; but it should be borne in mind that this was 16·45-candle gas, tested by the Carpenter burner, from a second-class Durham coal. At Tottenham they had a reputation for making about 12,000 cubic feet of gas per ton with horizontal retorts; but he did not think he could undertake to make 11,259 cubic feet of 16½-candle gas if he were compelled to keep the nitrogen in the gas down to less than about 3 per cent. He thought that in any works where the quantity of nitrogen in the gas was kept so low as this the make per ton would fall considerably below 12,000 cubic feet. In their joint report, they had enumerated the advantages of the vertical system on the Continent as being low labour cost, low charge for wear and tear, and a better description of coke (there were some samples before them to speak for themselves); while the yield of gas was very good under the circumstances, because it was all produced from coal. The ammonia was increased in quantity; and, as Dr. Colman had told them, the tar was very much thinner, and would undoubtedly result in saving much of the trouble experienced with high heats and horizontal retorts. One of the disadvantages was the heavy pressures in the retorts, to which Mr. Hayman had referred. Mr. Körting's system was to separate the nuts from the small coal, and put the nuts in a column up one side of the retort, so as to allow a free passage for the gas. Another matter which he should also regard as a disadvantage, though Mr. Hayman had called it an advantage, was the reduced quantity of cyanogen. Mr. Hayman alluded to it under the head of "Purification," and said that the quantity was reduced from 104·9 grains to 79·62 grains per 100 cubic feet. He thought those who troubled at all about cyanogen generally did so on account of extracting it; and he should think the reduction in quantity was rather a disadvantage. Before turning to the question of the cost of construction, he ought to mention one thing which would interest the members—viz., the discharge of the coke. In almost every instance the coke came out beautifully, without the slightest trouble. In one case at Dessau, one of the charges hung up, and they had considerable trouble to get it away; and finally they had to poke it from the top. If they had known this was going to happen, they would have timed the operation exactly; but they guessed it at about eight minutes. Anyway, it was no worse, but probably rather better, than some of the jams he had seen with a pusher in horizontal working, and some he had seen in inclined retorts. He should like to ask both Mr. Hayman and Mr. Woodall if they could give any indication of the relative cost of construction of verticals, inclines, and horizontals. The last they knew fairly well, and also inclines; but up to now they had very little information as to the cost of construction of vertical settings. To look at the settings in Germany, he should say, from the simplicity of the whole thing, that the cost ought to be less than horizontals, especially taking into consideration the economies that could be effected in the construction of the house. But they wanted some basis for comparison, as the whole thing was rather involved. When one saw the various makes of gas per ton—water gas being introduced in some cases and not in others—it was quite evident that the fair basis of comparison was not the gas produced per retort. In Mr. Woodall's latest retort, his carbonizing capacity per day was 51 cwt. A 4-metre retort compares rather under an ordinary horizontal retort in its carbonizing capacity per day; but it amounts to about 27 cwt., or rather less. It was evident, therefore, that the basis for a comparison of the cost must not be per retort. Nor did he think it should be determined by the carbonizing capacity per day, because of the water gas added in some cases with the vertical retort. In these days they were coming to the conclusion that the calorific value of the gas was the only thing that mattered; and with regard to the producing plant, the quantity of gas it made was very important. He therefore suggested that a good standard for comparison would be the quantity of gas of (say) 550 B.Th.U. calorific power which the plant could turn out in 24 hours. By dividing the capital cost by this figure, they would arrive at a very fair basis of comparison. His impression of the vertical retorts was so good that undoubtedly, when they next required an extension at Tottenham, he should recommend their adoption; but whether it would be on the Dessau or the Woodall system must depend to a large extent, among other things, on the capital cost.

Mr. E. Allen (Liverpool) said he wished to speak particularly on Mr. Woodall's paper. But, in the first place, he must express his gratitude to Mr. Hayman for the trouble he had taken to give the members the very important information he had furnished as to what was being done at

Dessau. Their eyes had for a long time been turned towards Germany, and they had received a great deal of information from the investigations of their German friends. The members of the Institution were greatly indebted to Mr. Woodall for his contribution; and they would all heartily desire the success of him and Mr. Duckham, their fellow-members. They were glad to know that by their efforts and courage they were apparently taking, if not the forefront, a very prominent position in connection with vertical retorts. The system of continuous carbonization was still, to his mind, the ideal one; and the particular reason why Liverpool took an interest in Messrs. Woodall and Duckham's vertical retorts was because of the impression they had that, the conditions being constant, a gas of either high or low illuminating power might be supplied from hour to hour. This opinion was not formed without consultation with the patentees; and the only reason why the experiment at Liverpool was discontinued had been accurately stated by Mr. Woodall. Unproductive though the experiment was, owing to some troubles with the plant, it was clearly shown that they could not obtain gas of anything but very low illuminating power. As they all knew, the very severe standard they had in Liverpool made this a matter of importance. Though they could have arranged, by using a large proportion of rich gas, to make use of (say) 12-candle gas, when it came to something like 5 or 6 candles the matter proved, under present conditions, to be altogether impossible; and therefore the experiment was discontinued. There were difficulties especially with the coke-conveyor; and it had been a matter of very great pleasure to him to know that this appliance had been set aside, and that the new method had proved most successful. Messrs. Woodall and Duckham deserved the admiration of the Institution and the gas profession for the courage and determination they had shown to put this system into a practical condition, such as might be well considered by those who had to provide for additions to their carbonizing plant. He trusted that by the middle of next week many of them would know more about the Dessau system; and he was quite sure they would all find a great deal to admire in Berlin. He was very proud of the fact that there were Englishmen who were working out this problem; and they earnestly desired their success.

Mr. J. P. Leather (Burnley) said the members were much indebted to the authors of both the papers now before them, dealing with an important subject which at the present time was engaging the attention of many who were considering what changes they should make in their carbonizing plant in future installations. They would be able to discuss Mr. Hayman's paper better after having visited Berlin; but they must do the best they could with it at present. In both papers members had put before them the increased results obtained by vertical retorts in comparison with those previously in operation, including a greater quantity of gas. He was struck, as Mr. Broadberry had been, with Mr. Woodall's statement that the coke was lighter, because one rather expected that in a vertical retort it would be denser and closer, and consequently go into less bulk. He supposed this was so in the Berlin retorts. The quality of coke made must have a certain financial effect, though some of them could not sell any more, however much the quality might improve. With regard to the tar, Dr. Colman said managers would appreciate the advantages of a thinner tar; but he did not say anything about it from the point of view of the tar itself, only in regard to there being less trouble in the works. Mr. Hayman seemed in this case to claim an actually higher value for the tar; and Mr. Körting had recently claimed an advantage of 25 per cent. for it, though he did not know whether or not this would turn out to be so in England. He presumed there was less pitch, which was a very important—sometimes the most important—part of the tar, from a financial point of view. Whether or not the improved quality of the pitch would make up for the diminution in quantity, he did not know; but he should like to learn why the tar was actually improved, and whether it would be so in English practice. An increased quantity of ammonia was claimed by both systems. With regard to labour, Mr. Hayman said he had a saving, because he was using gravity; but this was just the claim made when they were invited to use inclined retorts. He was one of the earlier ones to visit, in 1890, the Southall works of the Brentford Gas Company, having been told that a man could go into the retort-house and make gas in a black coat; and they had seen an advertisement in the Technical Press of a little girl drawing a lever and charging inclined retorts. The adoption of gravity, in the place of muscular or mechanical power, was the claim then made; and he did not see how, on that ground, the vertical retort on the Dessau system was going to be any great saving over the inclined retort. The German saving seemed to come about by the adoption of a long charge, and the knocking out of one shift of men—thus leaving the retort-house for one-third of the time without any men in it, if they had eight-hour shifts. These advantages would be as well realized, it seemed to him, by having inclined retorts charged full. Surely the difference in the results obtained did not depend on the retort being vertical, but on its being full. This was the difference, from the economical point of view, between the vertical retort systems and those previously in operation. From this standpoint, they might set the inclined retorts at a somewhat steeper angle, as Mr. Love did at Guildford, and put them on a brickwork foundation, which many would prefer to mounting them on stilts, and supporting them on vertical stanchions. Before passing to what he thought might be an advantage in the Woodall-Duckham system, he would like to refer to something he found on visiting Guildford recently. German engineers claimed that the cause of their increased results was that the gas passed up the inner core of coal in the retort, and was thus kept away from the surface of the retort or the hot coke; but he must confess that he could not see how this was possible. If they opened a retort which had been charged about an hour, and tried to draw it, they found that all the coal seemed to be in a thick, pitchy, almost impervious mass; and he did not believe this explanation until he inspected one of Mr. Love's retorts at Guildford. There he saw a retort opened after it had been charged for about an hour. Round the shell the coal was caked, so that there was a layer two or three inches thick; then a thin layer which was somewhat tarry; and then the interior of the retort was full of dry nuts of coal, which began running out by gravity—showing that there was really something in the contention that the centre of the retort could form a passage for the gas to pass up. It seemed to him that the explanation of this lay to a considerable extent in the fact that the gas was very largely given off from the coal at a much lower temperature than they were formerly disposed to think. Probably half the gas, at least, was given off at a temperature below 1000° Fahr.; and if this were so, as the heat gradually made its way towards the centre, the centre core of the retort would remain for some time at quite a low temperature. The question, therefore, really came to be one between an intermittent system—whether a steep incline or a vertical—and a continuous system; and the remark had been made by Mr. Broadberry that there did not seem to him to be many reasons for adopting the latter. This system had always been the ideal to which he had looked ever since he began to study the question of carbonization, because he thought carbonization in closed vessels was just as much an ideal to be aimed at as purification in closed vessels, to which reference had been made by the President in his address. If they could carbonize in closed vessels, so that they did not have the smoke and discomfort which arose from ordinary charging and discharging retorts, they would have gained a great deal both in the comfort of the men employed and in the absence of discomfort in the neighbourhood of the gas-works. These seemed to him to be very great reasons in favour of the continuous system; and if they also secured a certain amount of saving in labour, it was so much to the good. But really it was the difference in the comfort of the men and the absence of nuisance that seemed to him to constitute the great advantage of a continuous system. Mr. Broadberry referred to the ease of control by altering the length of time the coal was in the retort. He (Mr. Leather) did not know whether or not this was what they did in Germany; but, as a practical man, he should have thought that altering the length of the charge according to circumstances from day to day, would disorganize the entire work.

Mr. J. H. Brown (Nottingham) said the members had two excellent papers before them; and their thanks were due to the authors, and especially to Messrs. Woodall and Duckham, for their energetic and successful efforts in elucidating the principle underlying continuous carbonization. Unfortunately, he was not so familiar with the Woodall and Duckham as with the Dessau system, but his interest was first aroused in the vertical-retort system in consequence of nuisance caused by his retort-houses, which were closely

surrounded by fairly valuable property. When the results obtained with these retorts were published in the Technical Press, his Committee at once decided that the system was one which warranted immediate attention. A small deputation went over to Cologne, Berlin, and Dessau, and were so pleased with what they saw that they immediately put themselves into communication with the Dessau people, and asked for a quotation for an installation of retorts suitable for one of the works at Nottingham. His people, however, were very cautious; and they were not prepared to commence the erection of so costly an installation unless the patentees would give some guarantee with regard to the carbonizing results to be obtained. Their obvious reply was that they were not accustomed to give guarantees; that they did not know the local coal, and therefore they could not guarantee the carbonizing results. The Committee met this by saying they would send a considerable quantity of Nottingham coal to Dessau to be carbonized in the retorts there, and then it would be possible to give a quotation on the results obtained. The Dessau people met them very generously—so much so, indeed, that the cost of sending practically 250 tons of coal only amounted to £22 or £23. The Birmingham Gas Committee also agreed to join in the expense, and sent over Dr. Davidson and Mr. Chaney to witness the experiment. They decided to commence by carbonizing the English coal that was already at Dessau; and they then realized the sincere contempt that people on the Continent had for candle power. They had a photometer, which was very good of its kind, but the system of testing was very unreliable; and in order to get a better check on the candle power, which was a most important question for them, they ran a separate supply from the inlet of the meter to a small test holder, which they filled every five hours, and for the next five hours they used this gas up on the photometer and partly also in analyzing it in the laboratory. The coal sent over was Nottinghamshire coal. They first carbonized it alone, and then added a percentage of cannel sufficient to maintain a standard of 16 candles. The results with this coal ran very closely with those obtained in Nottingham with the same coal and from horizontal retorts in the testing-station. In January, 1906, they tested the same coal, and found it produced 11,870 cubic feet of 13·83-candle gas, having a calorific value of 559 B.Th.U. gross and 502 B.Th.U. net. In Dessau, with the same coal, they obtained 12,130 cubic feet of 15·97-candle gas with a Carpenter burner; but when they tried it with the 16-candle power standard, they only obtained 8·74 candles. It was therefore obvious that the burner was doing an injustice to the gas. Not only so, but they had reason to believe afterwards that the filtering of the gas through the long length of pipe from the inlet of the meter to the test holder considerably diminished the illuminating power. To ascertain whether these vertical retorts would be suitable for their purpose, they endeavoured to carbonize 70 per cent. of coal with 30 per cent. of cannel; but though they obtained some comparable results, they found it reduced the make of gas. Instead of obtaining, as they expected, about 11,000 cubic feet of 22-candle gas, they only had something approaching 10,500 cubic feet of 18-candle gas with the Carpenter burner, and 13·4-candle gas with the No. 1 burner at the 5 feet rate. He formed the conclusion at the time that it was not of great consequence whether or not the coal used in vertical retorts was of good quality, so long as it was a good caking coal, because the results would be very much the same. They were particularly struck with the ease of control and with the satisfactory working of the plant generally. Their people were over there for about three weeks. After some time they were told that the stock of gas in the holders had been reduced very seriously, partly by reason of their interference, and that it would be necessary to put another bed of retorts to work at the end of the week. When it got to Tuesday (the plant being wanted on Friday), he began to be rather alarmed for the consumers in the town; but he was assured there was no occasion for this. On Thursday morning they began to light up the bed; and the following day at noon, within 30 hours at most, it was at a satisfactory temperature—quite equal to the others which had been working for some days. They proved this by the pyrometer. Mention had been made of the quality of the tar. Unfortunately, the samples they took had not been completely analyzed; but, from the experiments which had been partly completed, they could see there was a considerable difference between the tar from the vertical and that from the horizontal retorts. The percentage of free carbon appeared to be much lower; and the tar was nearly approaching that usually obtained from a Mond gas plant. With the present price of pitch, this should be of considerable advantage to the tar distillers, if not to the gas makers. He ought to have said that with the results of 12,130 cubic feet, the proportion of nitrogen was only 3·9 per cent.

Mr. T. Glover (Norwich) wished to make a few remarks with regard to the Special Purposes Fund which had been inaugurated, and which was being used in carrying out investigations—among other things, into the subject of carbonization. It showed that the fund was already bearing fruit, as the Committee had actually done some amount of work, as was seen by the report of Dr. Colman and Mr. Broadberry. He hoped this would encourage the members to use their influence to obtain donations and contributions to the fund. The whole of that day's proceedings showed the importance to the Institution of having a fund from which they could draw for all purposes of investigation.

Mr. R. G. Shadbolt (Grantham) said he took it that the authors of the two papers, when referring to calorific power, were speaking in gross terms. But there was a great difference between the gross and the net; and it would be well if they could arrive at some authoritative dictum on this particular point. When speaking of calorific value, they should say whether they were speaking of gross or net. This was very important. Another point he wished to call attention to was that any man in charge of a moderate sized or even small gas-works must not run away with the idea that there was this vast difference in yields between the new system and ordinary work. In ordinary working, they had lighting up and letting down, and all that kind of thing; whereas these tests were taken in installations which were used fully up to the hilt under the most favourable conditions. Mr. Allan, at Scarborough, obtained as his ordinary carbonizing results, from horizontal retorts, about 12,000 cubic feet of gas per ton of coal, for the simple reason that he worked one bench of retorts continuously, in season and out of season, summer and winter, under the most favourable conditions, and produced the best results; and the illuminating power he made up from another source. Another point he should like to refer to was with regard to the texture of the coke. This would always arise in a continuous system of carbonization, whether with horizontal or vertical retorts. He had experience several years ago of some retorts where they were constantly beating up the coal during the course of the carbonization, until when the ash was taken away there was left a fuel which it was practically impossible to burn unless under a forced draught, and by a supply of very good air. Taking this one extreme, and furnace coke as the other, they had different intermediate grades. Mr. Woodall threw a side-light on this when he told them that the bulk of the coke was about 25 per cent. greater from continuous vertical carbonization than that obtained in horizontal retorts. If they would stir up the charge at different stages of carbonization in ordinary retorts, as he had done when experimenting with the Yeadon revolving retort, the more they disturbed the coal the more difficult would the coke be to burn as fuel.

Mr. S. Glover (St. Helens) said he had been a student for many years of the details of carbonization, and had watched with great interest its development in vertical retorts in Germany, and had seen one of the most important installations at work. It therefore gave him great pleasure to find that some of the elementary difficulties had been overcome. After what he saw and had heard, and the impression given to them on the previous day by Mr. Hayman, with all due respect to their German friends, he would ask any gentleman present whether he considered that, after all, the German vertical retort was a scientific instrument at all. He doubted it very much. He questioned whether, if they took a retort at a certain temperature, and dumped the whole charge into it at once, leaving it there a varying length of time, in accordance with the temperature, until it had given off its charge, such a method could appeal to the English mind as the scientific distillation of gas coals. They must realize that when the charge was so dumped into the retort, the first part of the working was carried out at a very much lower temperature than it appeared to be at the moment; and the absence of control of the working of the German vertical retort seemed to be a very serious drawback to the system. He believed in the absolute control of the retort. Many years ago, when beginning his work on this subject, he emphasized the importance of the capacity

DR. ROSTIN'S APPARATUS

FOR

AUTOMATICALLY LIGHTING AND EXTINGUISHING STREET LAMPS.

SAVING 5/- TO 13/- per Lamp per Annum.

LIFE OF APPARATUS UNLIMITED.

ABSOLUTE LAMP COCK. NO UNCERTAIN VALVES.

READ what Lighting Authorities say—

"Indisputable success."
"Most beautiful arrangement that can be conceived."
"Most modern improvement which scientific people have brought forward."
"It has revolutionised public lighting."
"Realised highest expectations."
"It is strongly built and requires little attention."
"It saves in our district 8s. 4d. per Lamp per Annum."
"The Lighting is performed with the ordinary increase of pressure at dusk."
"Bids fair to constitute a landmark in the history of gas."

ANY LARGE NUMBER ON TRIAL FREE OF COST.

INSTALLATIONS MADE EVEN WHERE PRESSURE SEEMS TO BE PROHIBITIVE.

A. LANDSBERGER, OXFORD COURT, CANNON STREET, LONDON, E.C.

AWARDS

LONDON 1885 LIVERPOOL 1886 ANTWERP 1885

Telephone 897.
Telegrams,
"FOOCHOW" MANCHESTER

DONALD MACPHERSON & Co Limited

Manufacturers of

METALLIC OXIDE PAINTS

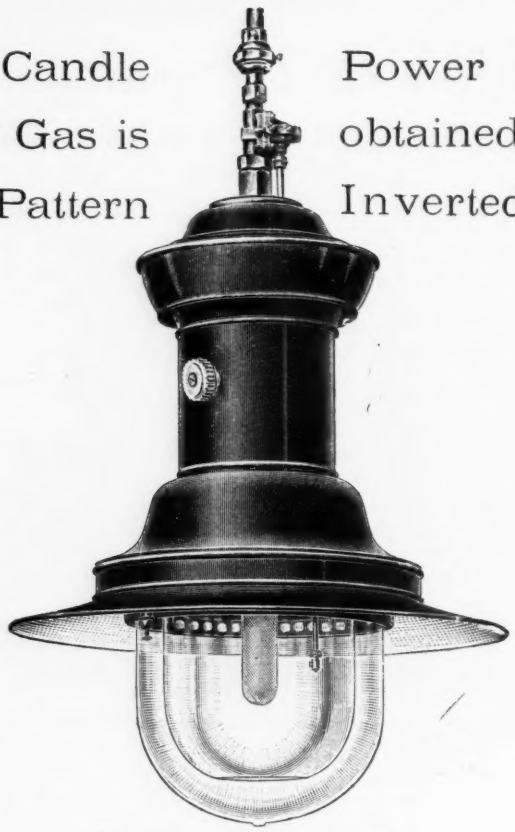
Managing Director, S. W. TAMPLIN.

Knott Mill, MANCHESTER

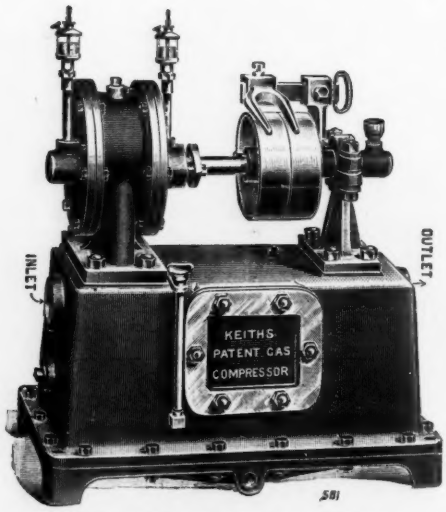
THE KEITH LIGHT.

60 to 70 Candle Power per Cubic Foot of Gas is obtained from the 1908 Pattern Inverted Burners.

60 to 300 Candle Power
WORKSHOP FITTING.



500, 1000, and 1500 Candle Power
ARC LAMP.



KEITH ROTARY GAS COMPRESSOR.

60 to 150 Candle Power
ORNAMENTAL FITTING.

Full particulars on application to:—

JAMES KEITH AND BLACKMAN CO., LTD.,

27, FARRINGDON AVENUE, LONDON, E.C.

of the vacant space over the coal in horizontal retorts; and this subject had continued to receive considerable attention. He believed that if they had a retort of which they could not control the charge and (as Mr. Woodall emphasized) the discharge, and could not control the temperature of, they had an unscientific instrument for doing what was really more scientific than had hitherto been realized. They had to look for an installation by which they would get the best results from every ton of coal they carbonized, not only from the gas maker's point of view, but also from the point of view of the residual products. The absence of any difficulty with the stopping of the bridge-pipe in the German retorts was simply the result of the deposit which began to form at the end of each charge being dissolved out each time a fresh charge of coal was put in. He could not help thinking the decomposition of the hydrocarbons towards the latter part of this intermittent system led to a good deal of decomposition of hydrocarbons they wanted in the gas, and that the freedom from trouble was due to the fact that a lot of the work was done at a very low temperature, when the charge was first put in. He was a great believer in the continuous system. If they took the whole output of a gas-works, they might get the average result of the fully burnt-off retorts, the partly burnt-off ones, and the newly-charged ones. With a regularly charged retort, however, working continuously, they would get regular results from each retort; and if they had these, they would get a better average. He congratulated Messrs. Woodall and Duckham upon the work they had so persistently carried out, against so many disappointments and at very great cost; and he wished them that ultimate success which he believed they would achieve. These results would be arrived at by treating the English gas coals in a much more scientific manner in future. To this end, his Committee, though it was a corporation committee and not a gas company, had authorized a very important installation of continuously charged vertical retorts to be put up; and he hoped to be able to give the results of the working of those at St. Helens. He wished to have them earlier; but they would be reliable when they were published. He had had to ask his Committee to buy property in order to make room; and they were just now putting down a complete works—condensers, purifiers, exhausters, station meters, and everything complete, so as to allow them to give the exact results of the continuous system.

The PRESIDENT said he regretted, on account of time, to have to close the discussion, but he could not do so without saying a word in recognition of the extreme courtesy they had received from their German friends. They knew, of course, that Mr. Körting had promised something for the Institution meeting, and he had, as they were aware, given all facilities for every engineer to see what there was to be seen. In addition to this, they had been invited officially, as an Institution, to Germany; and a very worthy representative had been sent here to tell them all about the subject, even in the same week that the German Association were meeting in Berlin. They owed a debt of gratitude to Mr. Hayman for giving up his own meeting to come over. As they had heard from Dr. Colman, Dr. Bunte was to present his report to the German Association this week; but he had sent Dr. Colman the facts, and had given him permission to use them, probably some hours in advance of their own Association.

Mr. CHARLES HAWKSLEY (London) suggested that any gentlemen present who wished to make remarks on the two papers, but were unable to do so for want of time, might be allowed to send in their contribution to the discussion in writing.

The PRESIDENT said this might, of course, be done.

Mr. HAYMAN, replying upon the discussion, said it showed the great interest they all took in the subject of vertical retorts, which he thought would be the plant of the future; and he should like to add his tribute of admiration to Mr. Woodall and Mr. Duckham for their patience and perseverance in trying to elucidate the fascinating idea of continuous carbonization. Time alone could show how the results turned out, especially with regard to wear and tear. He feared very much that the wear and tear of the plant taking out the coke would be pretty considerable. With regard to the relative cost of verticals and slopers, to which Mr. Broadberry had alluded, he should like to refer to the article which Mr. Körting contributed to the "JOURNAL OF GAS LIGHTING" on the 14th of January, in which he found the figures given very fully. Mr. Leather had referred to the value of the tar. As a matter of fact, they got 25 per cent. more for their tar than they did for that produced by other systems. With respect to the saving of labour in verticals over slopers, they put a great deal more coal into the former than into the latter; and naturally the labour results must be better. They divided the shifts in the Mariendorf works into two, of four men each; and there was one shift, of at least four hours, when nobody was present at the verticals. There was, however, a foreman looking after the slopers in the same house; and he attended to the verticals if necessary. Many of them had seen exactly how they worked; and he need not enlarge upon this. The British thermal units were given in the gross. He had received that day from Dessau some results of tests they had been making to find the quantity of gas produced from Boldon coal, of an illuminating power of 14 English candles at 15° C., with the Carpenter burner. There were 14·17 tons of coal carbonized; the actual weight of the charge was 9·4 cwt.; the duration of the charge was eleven hours, including two hours steaming; the total gas production was 205,827 cubic feet; the production per retort, 14,967 cubic feet; the production per ton of coal carbonized, 14,522 cubic feet; the heating power at 15° C., 559 B.Th.U.; and the illuminating power at 5 cubic feet per hour, 14·59 candles. He thought this might be considered as a very good result indeed.

Mr. WOODALL said when he received the kind request from the President and Council to read a paper on continuous carbonization, he determined when writing it to give a brief historical sketch of the work he had had the honour of carrying out in conjunction with Mr. Duckham. But he had no idea then, and had not now, of attempting to make any comparison with the work of their German friends. He had watched it with the greatest interest and admiration, and he rejoiced very much at the splendid results they had obtained. There were one or two questions which had been put; and he would answer them as briefly as possible. With regard to Mr. Broadberry's remarks particularly asking where the advantage of continuous carbonization came in, as compared with other vertical retorts, he should say they could only make one claim, and that was that they never opened their retort; they did not discharge the coke and then put in a cold charge of coal, but kept working under the same conditions, and with no cooling draughts. There was no cold air travelling through the retort; and so they had a constant cycle of operations, with a more constant condition of temperature. With regard to the nut used, Mr. Leather replied to that question; and he rather felt inclined to keep to his original idea, that the nut was far simpler than altering the entire conditions of working, and running the charge for a longer or shorter period, though he did not imagine that had to be often done. As to the coke, perhaps his remarks had led to a little misunderstanding. He said that vertical retort coke filled 27 bags, compared with 20 bags with ordinary horizontal working. He told them this because he considered it a matter of great interest. But it had always been understood that vertical retort coke was a great deal heavier than that obtained from horizontal retorts. There was a great demand for it in the neighbourhood. It was much better looking; and they were using it in the carburetted water-gas plant, and getting infinitely better results. As far as Mr. Shadbolt's remarks were concerned, they were very interesting; but he would assure him that the coke from vertical retorts was very much better and easier to burn, and more free from breeze, than that made in horizontals, despite the fact of its being lighter. He had only to thank the gentlemen who had spoken for the kind remarks they had made with regard to this process.

DESCRIPTION OF THE NEW GAS-WORKS AT VALBY, COPENHAGEN.

By J. IRMINGER, of Copenhagen.

As an introduction to the description of the new gas-works at Valby, the writer thinks it may be of interest to give some figures first of all relating to the gas consumption, &c., of Copenhagen.

In the year 1888, the system of differential prices for gas was introduced. Since 1890, illuminating gas has been sold at 4s. 11d. (4·50 kroner) per 1000 feet, and gas for cooking and motor purposes at 3s. 3½d. (3 kroner) per 1000 cubic

feet. Fig. 1 shows graphically the annual consumption of illuminating and cooking gas from the year 1858. It will be seen that since 1890, when the price of cooking gas was again lowered, the increase has been very considerable. For the

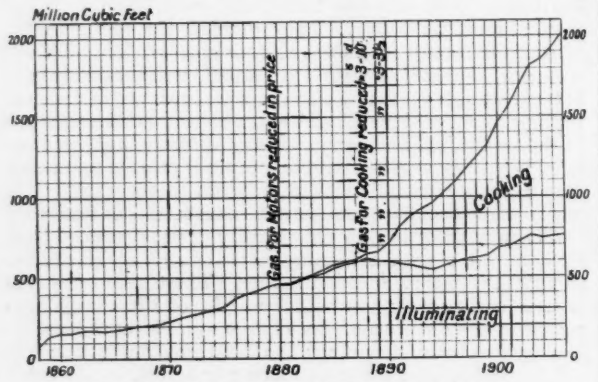


Fig. 1.—Gas Consumption in Copenhagen, 1858-1907.

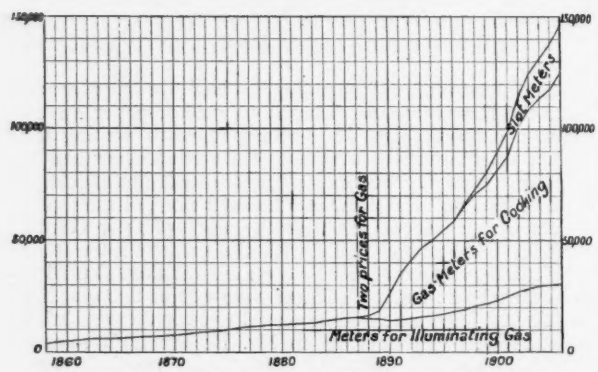


Fig. 2.—Number of Gas-Meters in Copenhagen, 1858-1907.

year ending March, 1907, the total consumption was 2021 million cubic feet, including 153 million cubic feet of water gas. The maximum per day was 8,548,000 cubic feet, and the minimum per day 2,824,400 cubic feet. The year to March, 1908, showed again an increase of more than 6 per cent.

The curves comprising fig. 2 are plotted to represent the number of meters in use from the year 1858 to 1906. In proportion to the population (which in 1907 was 434,000), the number is very large. The following are comparative figures for the years 1900 and 1907:—

	For Lighting.	For Cooking.	Slot Meters.	Total.
Year ended March, 1900 .	23,066	57,641	8,510	89,217 meters.
,, ,, 1907 .	30,632	89,876	25,521	146,029 ,,

At the present time, the total number of meters in use is 152,000 (including 30,000 slot meters), which is equivalent to one meter for every three inhabitants. The comparative figures for consumption per year per meter are as follows:—

	For Lighting.	For Cooking.	Slot Meters.
Year ended March, 1900. .	19,756	12,222	8,292 cubic feet.
,, ,, ,, 1907. .	16,220	11,597	9,900 ,, ,,

The reduction in the consumption of gas for lighting purposes is due partly to the incandescent burners, now generally used, and partly to the increasing number of meters.

The consumption of gas per inhabitant has been:—

	For Lighting.	For Cooking.	Street Lamps.	Total.
Year ended March, 1900 .	1,272	2,164	290	3,726 cubic feet.
,, ,, ,, 1907 .	1,131	2,893	296	4,320 ,, ,,

The illuminating power of the gas is 15 Hefner-candles or about 13 English candles; and the heating power about 5000 kilogramme calories per cubic metre (lower value) = 575 B.Th.U. It may be well to point out that the illuminating power, in accordance with our custom, was tested by the No. 1 "London" argand burner, but when tested by Mr. Carpenter's burner, it gave an increased illuminating power of about 4 English candles.

Site of Works and Capacity.—The constantly-increasing gas consumption made it necessary to build a new works to supplement the two older ones (Eastern and Western). A good site was secured outside the town at Valby, and 87 acres laid out for the works (fig. 3), which, when completed, with extensions, will consist of four retort-houses, each producing about 4 million cubic feet per diem, or a total daily production of coal gas of 14 to 16 million cubic feet. Besides this there is room for a carburetted water-gas plant of 6 million cubic feet capacity or even more, so that the total possible

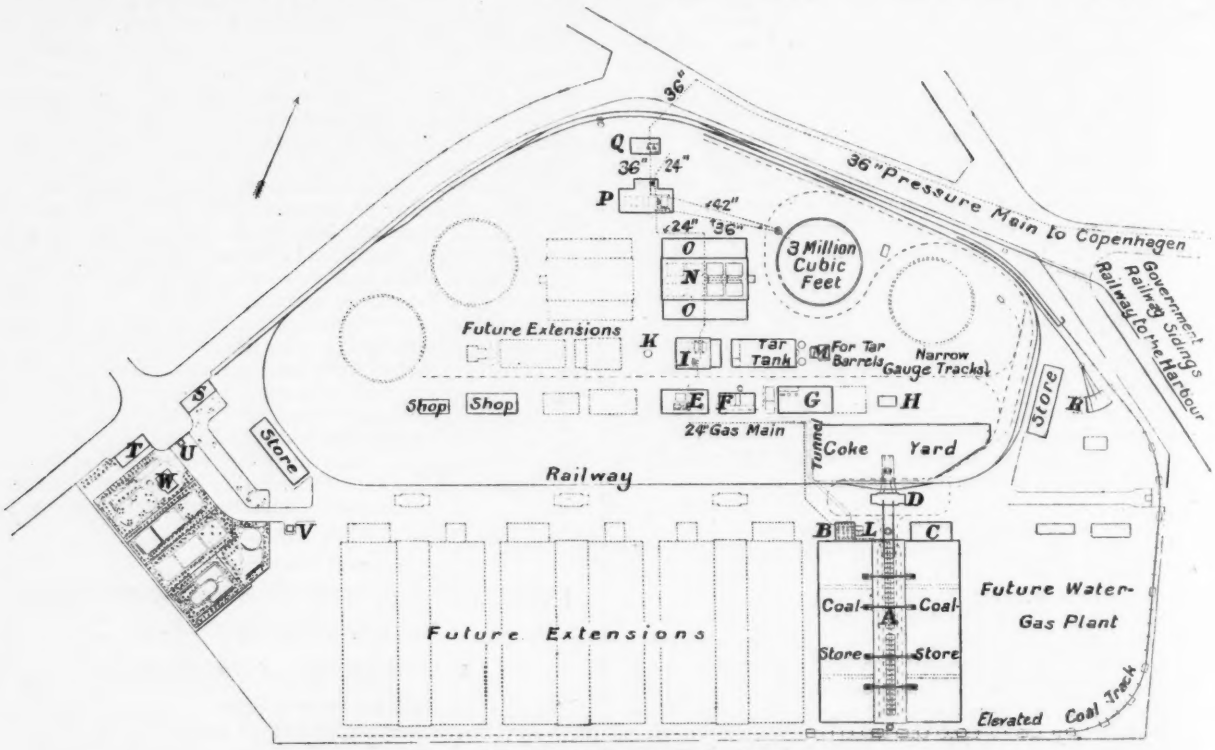


Fig. 3.—Plan of the Valby Gas-Works, Copenhagen.

A. Retort-house.
B. Condensers.
C. Mess-room.
D. Coke-building.
E. Exhauster and engine house.
F. Boiler-house.
G. Ammonia works and store.
H. Laboratory.
I. Washer and scrubber house.
K. Water-tower.
L. Tar-well.
M. Tar-centrifugals.
N. Purifier-house.
O. Revivifying-house.
P. Meter and governor house.
Q. Gas fans.
R. Locomotive shop.
S. Offices.
T. Employers' dwelling house.
U. Porter's lodge.
V. Fire-engine.
W. Manager's house.

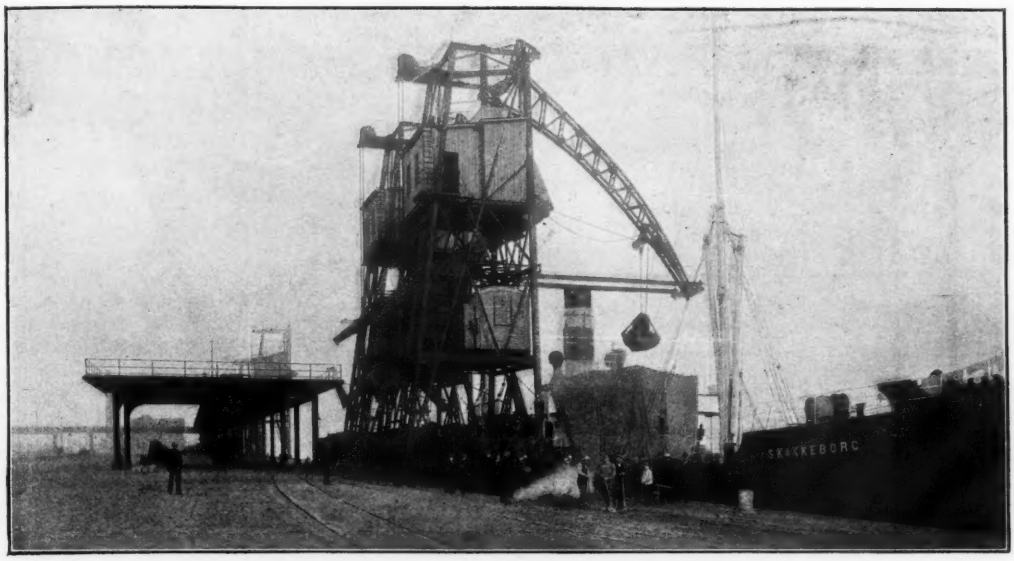


Fig. 4.—Hunt's Coal Cranes on the Harbour Quay.

production eventually will be at least 20 millions per day. Only one retort-house is now built. On the plan (fig. 3) are shown the buildings now in use; future extensions being indicated by dotted lines.

Coal Supply.—The works are connected to the harbour by a railway 15,000 feet long for the transport of coal and other materials. On the quay are two of Hunt's coal-cranes, working with grabs of 1 ton capacity (fig. 4). The coal is loaded into 10-ton waggons with bottom doors, and locomotives, weighing 20 tons, bring ten waggons at a time to the works. The two cranes can unload 800 tons per day. When the coal-waggons arrive at the works, the locomotive pushes five of them up the viaduct to the coal-stores. The viaduct, made entirely of reinforced concrete, is inclined; the gradient of it being 1 : 45. The first portion of the incline is made of earth, with retaining walls of reinforced concrete. The viaduct proper is 566 m. (1860 feet) long, with curves of 60 m. radius (200 feet). The part alongside the coal-stores is horizontal, and 13·6 metres (45 feet) above the ground level. The whole length of the viaduct is supported on 71 pillars, the distance apart varying somewhat. Between the pillars are double-arched girders, over which is the platform supporting the sleepers and rails.

Opposite each coal-store are five coal hoppers; and under these is the automatic railway by which the coal is taken into the store in one-ton automatic waggons working on Hunt's system (fig. 5). A heavy counterbalance weight, lifted by the energy of the filled waggons, carries the empty waggons back again. The viaduct was tested with full load; and the largest arches showed a depression of ½ to 1 mm. (0·019 to 0·039 inch), going back again to zero on the removal of the load. The cost of the viaduct was about two-thirds what it would have been if constructed in steel. It may be stated here that reinforced concrete has been largely used throughout the whole works. All the floors and the pillars (except in the retort-house), the tar, ammonia, and water tanks, and even a roof of large span for the ammonia-works, have been constructed with this material; and the author considers it very satisfactory, especially for gas-works, for the reason that it resists the fumes much better than steel does, it requires no painting, and is very fire-resisting. The only objection appears to be that it must be of exact construction, and very carefully put together by experienced men; otherwise it will not be successful.

On each side of the retort-house (fig. 8) is a coal-store capable of taking in 15,000 tons of coal. Each store is provided with four coal breakers and elevators driven by electric power. There are two tunnels (of reinforced concrete) with openings on the sides, partly for conveniently bringing the coal from outside the store to the breakers, and partly for isolating the coal in case of fire. Near these tunnels are electric cranes for elevating materials to the benches, &c. The retort-house has on each side four large hoppers capable of containing sufficient coal for a night's carbonization.

Retort-House.—In the retort-house are 32 settings, divided in two benches, each with eight through retorts of 16 inches

Fig. 5.—Hunt's Automatic Railway at the Copenhagen New Gas-Works.

by 22 inches-section by 20 feet long, and with producers on each side. The compressed air machinery for charging and drawing the retorts was supplied by West's Gas Improvement Company, who have also made the coal and coke conveyors, elevators, and settings (figs. 6 and 7). The coke is drawn by conveyors running in front of the benches, and is then elevated to the coke building by two inclined elevators. The writer has found it is a good plan to quench the coke with steam generated by the half-extinguished coke. The inclined elevator is therefore cased-in for a length of about 50 feet, and air current is as much as possible avoided. The regulation of the expansion of the coke conveyor is of great importance, and special counterweights are arranged for this purpose, thereby considerably reducing the wear and tear. The conveyors are driven by two electric motors, and experiments have shown that each of the two conveyor chains (800 feet long) requires to actuate it, when empty, 13-H.P., and when conveying coke from 16 ovens practically the same power. The inclined elevator, 200 feet long, requires, when empty, 5½-H.P., and when filled with coke, 6-H.P. At the Eastern Gas-Works, with steam-engines, it was found that two horizontal and one inclined conveyor, 1200 feet long, required, when empty, 16 H.P., and when quite filled

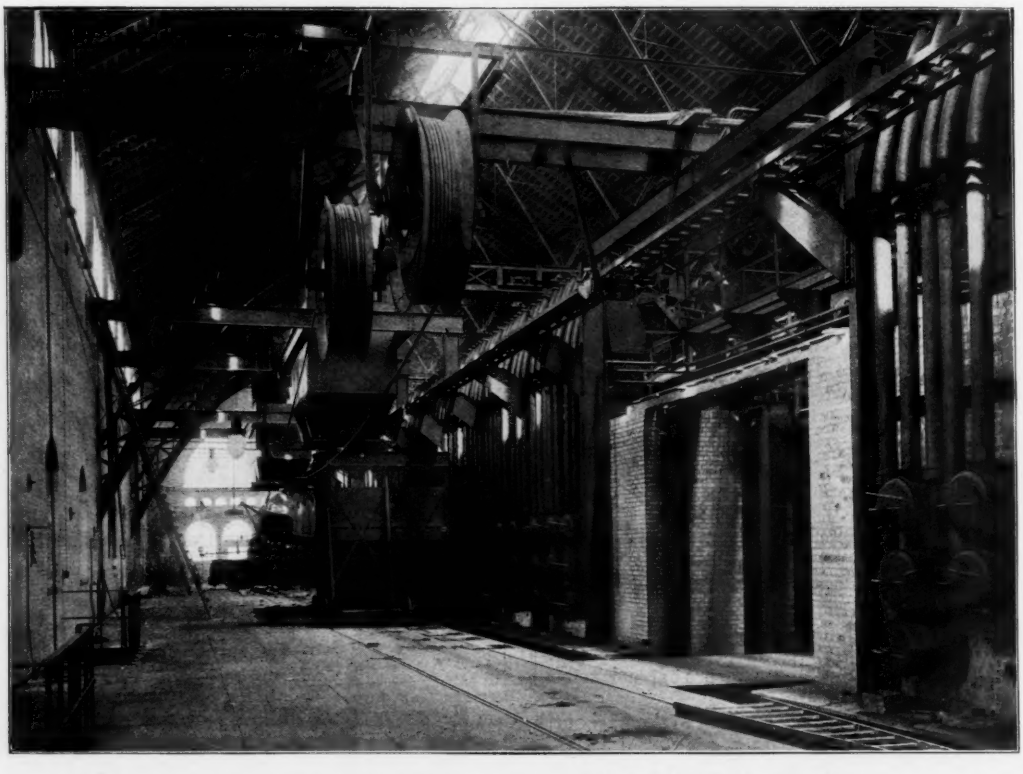


Fig. 6.—West's Compressed Air Stoking Machinery at the New Gas-Works, Copenhagen.

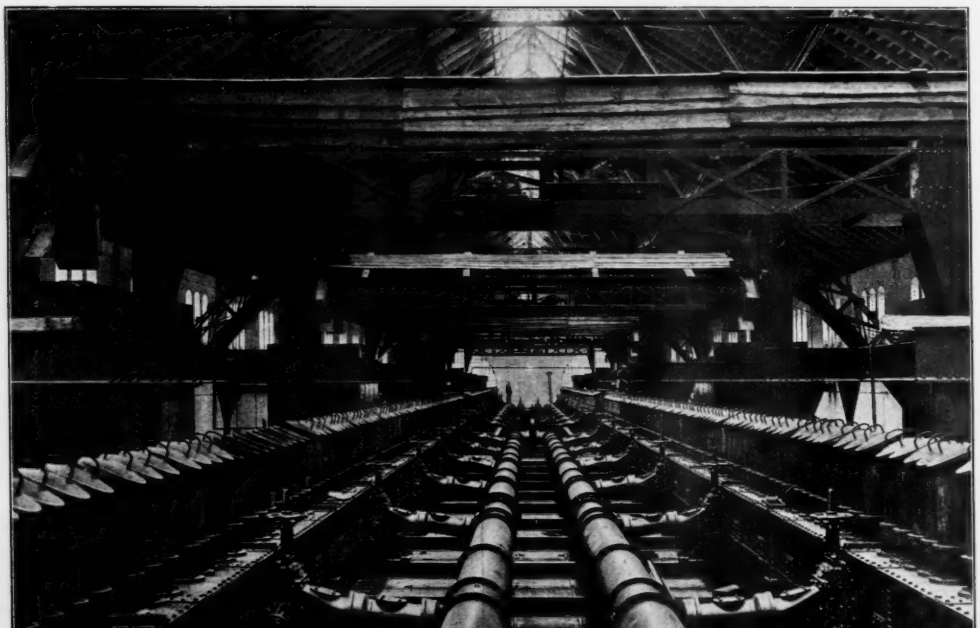


Fig. 7.—Above the Retort-Benches.)

with coke, 20-H.P. It will thus be seen that the weight of the coke itself makes little difference in the power required to operate the conveyor.

For preventing stopped ascension pipes and thick tar, ammoniacal liquor is pumped into the hydraulic main. There is one hydraulic for two settings, and the ammoniacal liquor is admitted in each end of it; the proportion being about 1 cubic foot per 1000 cubic feet of gas. The same system has been in operation for some years at the Eastern Gas-Works on similar benches. Before this method was introduced, serious difficulty occurred through stopped pipes and thick tar in the hydraulic; it being impossible to regulate the flow of gas to each side. One stand-pipe (6 inches) would be hot and the other cold; thick tar being the result. This could be remedied by lifting the tar-regulating valve; but the trouble soon returned. After working a month in this manner, ammoniacal liquor was let in as stated above, and immediately the tar was good, and the gas equally divided to both sides. Before ammoniacal liquor was used, the tar contained 2 per cent. of light oils (under 140° C.)

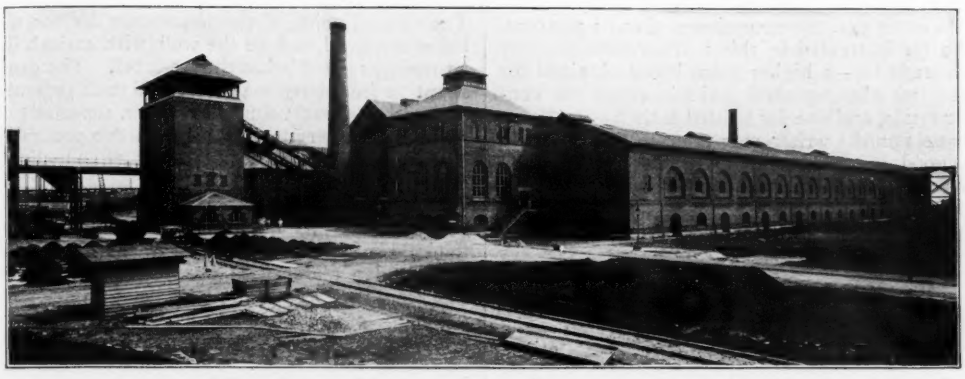


Fig. 8.—General View of the Works—Showing the Coke Building, Coal Stores, &c.

Fig. 9.—The Stokers' Mess-Rooms, Baths, &c.

and 4 per cent. of water. With the ammoniacal liquor admitted, the analysis showed 4 per cent. of light oils and 8 per cent. of water—clearly indicating the advantage obtained. No trouble from this source is now experienced.

Attention may be called to the arches in the combustion chamber being of silica bricks throughout. This prevents the retorts supported by them sinking, as the silica bricks expand a little. Arches of ordinary clay bricks of best material have been found to sink more than 6 inches, the bricks not being burnt at a sufficiently high temperature, and contraction subsequently taking place.

Coke.—The coke building (fig. 8) contains three large hoppers, coke-crushing machines, &c.; and the coke can be filled into waggons or taken to store. Over a bridge equipped with two electric lifts, the coke is brought in small waggons from the hoppers to the coke-yard. Lifts are used to carry the coke from the yard to the crushers.

Condensers, &c.—The condensers are placed in a building close to one of the coal-stores (fig. 8), and are of the combined water and air type. There are four sets, each having four cylinders filled with 4-inch water-pipes (16 in each of them), the water in the pipes flowing in a contrary direction to the stream of gas. Some of the hot water is used by the men for baths, &c. (fig. 9); the remainder being utilized for quenching the coke. Near the condensers is a deep tar and ammoniacal liquor tank well, from which the tar and liquor are pumped to the large tar-reservoir.

Engine-House.—The engine house (fig. 10) contains two sets of exhausters (each of a capacity of 250,000 feet per hour). There are also two large three-cylinder gas-engines connected direct with dynamos each of 150 K.W. capacity for generating electrical current at 220 volts pressure; and there is room for another when required. Electric power has been almost exclusively adopted—about thirty motors being distributed throughout the works; and some of the rooms are lighted by electricity. A small gas-engine is provided for starting the large ones; and there is a balancer-booster. The air compressors for the retort-house machinery, and an air-exhauster are also contained in this house, and on the upper floor is a room for accumulators. The retort-house and engine-house are connected by an underground tunnel, 7 feet high and 600 feet long, containing the pipes for compressed air, steam, tar, ammoniacal liquor, cold and hot water, &c.

Boiler-House.—In a building close by, two boilers are placed, fitted with mechanical stokers and forced draught, produced by electric blowers. The steam required is not large, as it is only used for the exhausters, air compressor, ammonia works, and heating. As before mentioned, most of the power is electrical; this being very convenient for long distances. The motors can be worked by common labourers—special engine attendants not being necessary.

Tar and Ammonia.—The ammonia works are built large enough for the entire works with extensions; but for the present, only one set of apparatus is fixed. As before mentioned, the roof of the building—62 feet span—is made of reinforced concrete. Near this house is the large covered underground reservoir for tar and ammoniacal liquor, with separating apparatus, &c., all made of reinforced concrete, and close by is a house containing the tar centrifugals which

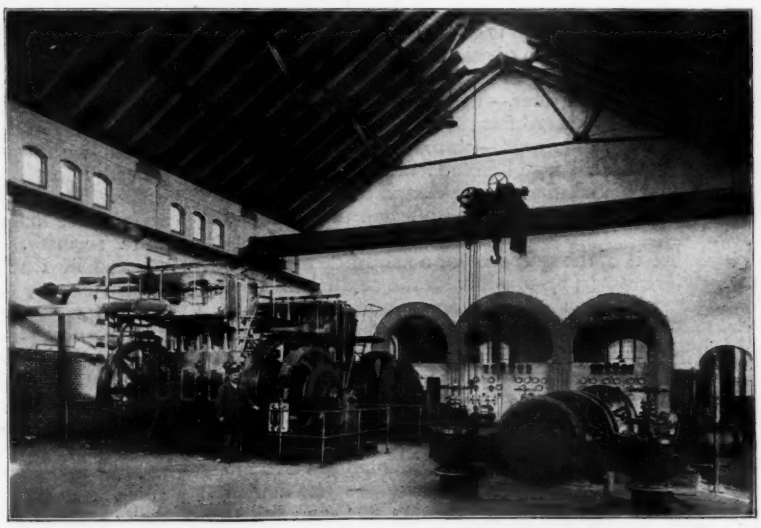


Fig. 10.—The Engine-House at the New Gas-Works, Copenhagen.

take out all the water with the exception of about 1 per cent. Nearly all the tar is treated in this manner, and is easier sold than the crude tar—a higher price being obtained for it. There are two above-ground tanks in reinforced concrete—one for crude, and one for treated tar.

In this connection the writer may refer to the necessity of having a good covered ammonia tank. Experiments which he has made show that with ordinary ammoniacal liquor, kept in a vessel, the following losses occurred:—

Loss of Ammonia per Cent.

	Temp. of Ammoniacal Liquor, 35° C.			Temp. of Ammoniacal Liquor 15° C.		
	Without Cover.		With a Loose Wooden Cover.	Without Cover.		With a Loose Wooden Cover.
After 10 days . .	28	..	11	0·6	..	0·4
,, 20 ,, . .	54	..	16	2·5	..	1·1
,, 30 ,, . .	61	..	20	4·8	..	2·1

Purifiers.—The gas is purified from tar and ammonia in another building by means of two Pelouze and Audouin tar extractors and two "Standard" washers, and then passes to the purifiers. The purifiers are four in number, 41 ft. by 31 ft., with water-lutes; and the building is large enough for four additional sets. The gas is admitted between the two layers of oxide, and leaves the purifier near the bottom and the cover. Hydraulic valves are used; and openings are provided in the bottom for emptying the purifiers.

On each side of the purifier-house is a building for revivifying the oxide. There are two storeys connected by lifts; the upper storey being the same height as the lower. The floor and columns are all of reinforced concrete; the columns at the base being covered with iron plates for preventing damage by the tools.

To assist the process of purification, a good deal of air is used—giving more gas. In the engine-room is fixed a small exhauster, driven by an electric motor, and the air is measured in a rotary meter.

The writer has used air, generally 4 to 5 per cent., for many years, and has had occasion to make many observations regarding the illuminating and heating power of the gas purified in this way. A long series of trials at the Eastern Gas-Works with about 5 per cent. of air, with gas from different sorts of coal, has given the following general results. Whether the air, let in before the exhausters, was heated to 65° C. or was of ordinary temperature, or the air was introduced before the condenser (in the hot gas), the result was the same. The loss in illuminating power was about ¼ to ½ candle; but rather often no reduction at all was observed, and it seemed to vary with the class of coal carbonized. The loss in heating power (if any) was negligible in all cases. In spite of this air, the analyses of the purified gas showed 0·6 to 0·9 per cent. of oxygen, and about the same when no air was used. With good coals 6 to 8 per cent. of air has been occasionally used. The amount of oxygen in the gas remained nearly unaltered, and the heating power was practically unchanged. A great number of gas analyses have also given the somewhat unexpected result that the quantity of nitrogen has been practically the same—say, 6 to 7 per cent.—whether the air was used or not. The writer has heard from some places that a quantity of air—say, over 2½ per cent.—corroded the gas-meters and apparatus; but he has not observed it at Copenhagen. The apparatus and meters on the works, and the meters in the town do not appear to have been affected in the slightest degree.

The author is of the opinion that a sort of carburation by the light oils must be responsible for the small loss in illuminating power; the heating power being unaltered.

Station Meter.—The building for the station meter is of very ample dimensions (fig. 11), having room for four large meters; but only one is erected now. Near the meter is an automatic bye-pass governor for the gasholders, which opens when the pressure is too low on one side or too high on the other.

Gasholder.—The gasholder (a three-lift one) has a capacity of 3 million cubic feet; the tank being 208 feet diameter, and 36 ft. 4 in. high (fig. 12). It is 25 feet above the sea level. The ground consists of a thickness of 23 to 25 feet of clay with layers of sand, and then lime going very deep. The deepest point of the foundation for the walls is 6 feet below sea-level, and for the well (with 42-inch inlet and outlet mains) 15 feet below the sea-level. The ground water is about 10 feet above sea-level; and such pressure in connection with a great volume of water, especially in the lime, made it necessary to pump up to 800,000 gallons per day. The earth was taken out by means of an incline and tip-cars drawn by a steam-hoist.

It was especially necessary to have the well for the pipes tight, and it was made so in the following manner. A thickness of 1 foot of concrete was first laid; on it ⅛ inch thick leaden plates with overlapping joints made with red lead were then laid—the plates being somewhat larger than the diameter of the well. The lead plates were covered with a layer of concrete 2 feet thick, and the plates were curved up tightly to the sides. The whole well was treated on the outside with asphalt. This construction proved to be completely tight, in spite of the 25 feet of water pressure on it. The tank wall, 3 feet thick at the top and 6 feet at the bottom, is made of concrete 1:3:5; but it was built in such a way that no timber shuttering at all was used. At first a course of bricks 9 inches broad, and three courses 4 inches broad were laid; after one or two days the concrete was packed in, the bricks being treated with mortar inside beforehand. Then again one row of bricks, 9 inches broad, and three rows, 4 inches broad, were laid, and the space so formed was filled with concrete, and so on. In this manner, two bricklayers could work round; and the concrete men would follow after them. When carefully executed, a wall so built will be found very strong and tight. All concrete, inclusive of that in the foundations, was made with a concrete mixer driven by a motor.

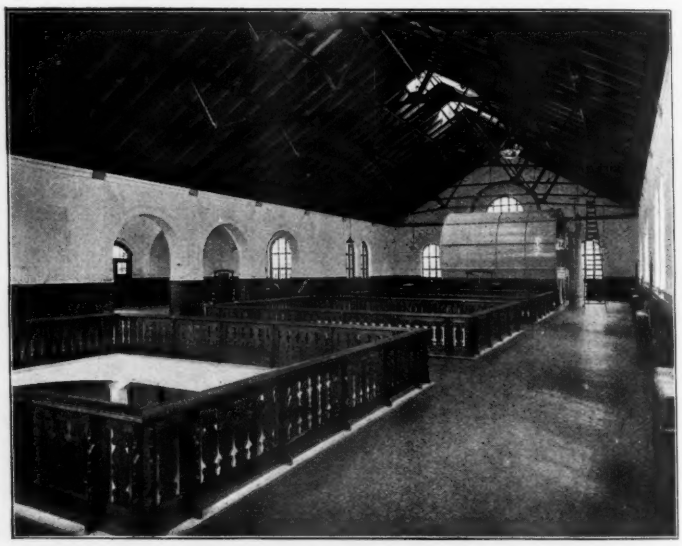


Fig. 11.—Station-Meter House.

For strengthening the wall against inside pressure, fourteen iron bands 4 in. by ¼ in. are placed in it at vertical distances apart of 3 feet at the bottom and 1 foot at the top. The earth is stamped outside in 9-inch horizontal layers, treated with water if necessary. Nearest, to the wall is packed 1 foot of the best part of the clays kneaded with water. The pressure of packed earth of this consistency is about twice that of the water, and the iron bands give an extra security. These dimensions are similar to those adopted in England; but on the Continent much larger dimensions are sometimes used, for the reason that there the earth pressure is not taken into account, because it is not known exactly. But experience shows that smaller dimensions may be followed with safety. At the first glance one would be inclined to think that the iron bands ought to be closer at the bottom than at the top, considering that the pressure of water is maximum near the bottom, and zero at the top. However, when a gasholder tank has broken, in most cases it has been found that the cracks were commencing in the upper part, and the reason must be that the earth packing is not so effective near the top, the weight of the earth being smaller, and the earth dried by the sun, and therefore going away from the wall. Also the upper part

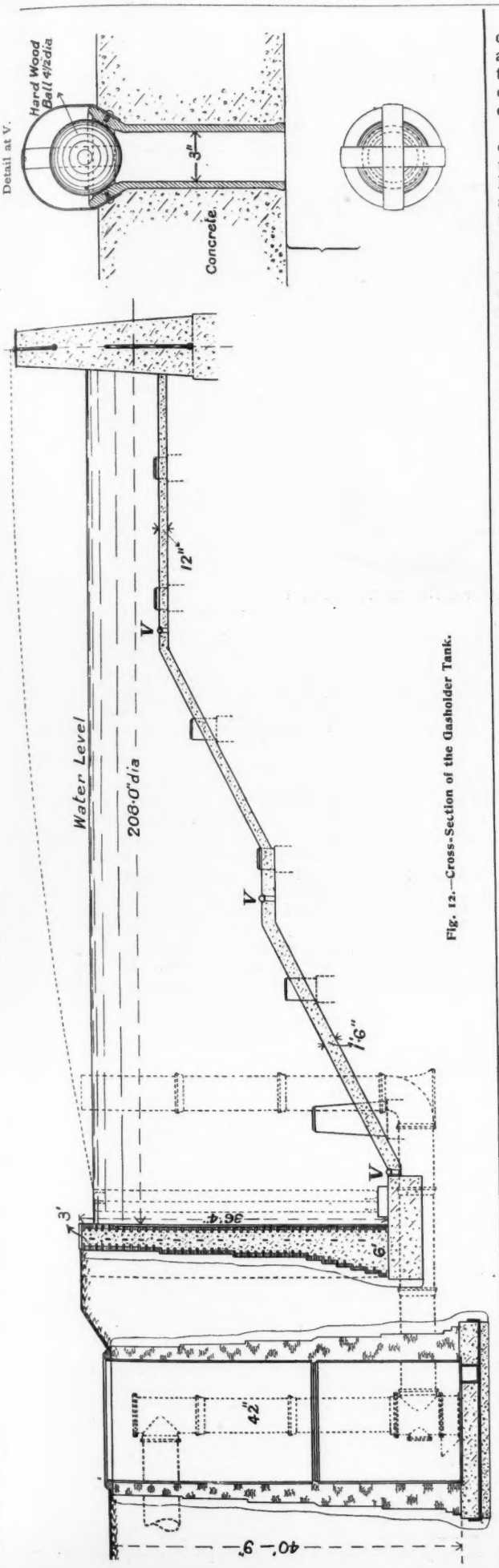


Fig. 12.—Cross-Section of the Gasholder Tank.

of the wall is more influenced by change of temperature, and therefore more inclined to break. The writer has read that also in the large gasholder tank at New York (15 million cubic feet capacity) the twisted iron bars are at a distance of 3 feet apart at the bottom but nearer each other at top.

The bottom of the tank at Valby is covered by a layer of concrete, 18 inches thick in the lower part and 12 inches for the remainder, in spite of a water pressure from below of at least 13 to 14 feet. Sometimes this layer is made very thick, and still it happens that the water gives so much pressure that it breaks the bottom when this is tight. A pressure of 13 feet, as in this case, would give a pressure of $13 \times 62{\cdot}4$ = about 800 lbs. per square foot; and this high pressure would break even a very thick bottom when the tank is empty. To counterbalance this, the writer has used the simple method first applied with success in a tank on the Eastern Gas-Works at Copenhagen under similar conditions twelve years ago. As shown in fig. 12, at different levels in the tank bottom are placed twelve pieces of 3-inch cast-iron pipe shown in detail in fig. 12. In the upper part of the pipe, which is conical and turned inside, is placed a ball of hard wood. Two pieces of iron prevent the ball from being thrown out, but permit it being lifted some distance. These pipes are about 1 foot long, going through the concrete, and connected below the concrete to drain-pipes especially connected with the springs.

During the building of the steel gasholder the water is going up through the pipes, lifting the balls, and the water is pumped from the bottom of tank. When the tank is filled with water, the balls will close the openings. Before pouring water in the tank, thin clay is distributed over the whole bottom. The tank has proved to be completely tight. If emptied later on, the balls will open themselves and prevent the bursting of the bottom.

Centrifugal Blowers.—After the gas has passed the holder, it is pumped to the town by means of two centrifugal blowers (one reserve), each 900,000 cubic feet capacity per hour, driven by electric motors. The pressure can be raised to 24 inches; and the gas passes through a 36-inch main, 15,000 feet long, to the Western Gas-Works, and thence to the city. A 3-inch return pipe indicates the pressure at the Western Gas-Works; and the pumping is controlled by this means. If the gasholder is empty, and the pressure is reaching 1 inch, a bell governor immediately breaks the current. Besides this high-pressure main, there is fitted an ordinary governor at the gas-works connected to the low-pressure mains supplying the neighbourhood.

Water Supply.—The gas-works has its own water-works, with an artesian well, and the water-tank (of reinforced concrete) is built on a tower which also contains ammoniacal liquor tanks (fig. 13).

Works, Railway Stores, Offices, &c.—The traffic on the gas-works is accomplished by means of a railway system surrounding the whole area, and connected to the harbour and to the Government railways. The locomotive shop and turn-table are situated near the eastern side. Besides these lines there are narrow gauge railways all over the premises, and a small 4-ton locomotive drags the waggons. These narrow railways are also laid inside the retort-house for bringing out ashes, and for use in case of accident to the coke-conveyor chains. The coke would then be drawn directly in tip waggons and passed through openings and shoots in the iron floor. Further on have been built stores, a large engine-shop driven by electric motors, laboratories, &c. Fig. 13 gives a bird's eye view of several of these buildings.

Mess Rooms, &c.—Mess rooms, baths, lavatory, kitchen, &c. (fig. 9) are provided in a fine three-storied building, near the condenser house, having plenty of air and light. In the basement are the lavatory, and baths, together with the heating and ventilating plant, driven by electric fans. The other storeys consist of the mess rooms, with glazed tiles on the walls, kitchen for the men and for the canteen, foremen's rooms, &c., and a library, containing weekly illustrated papers. Each man has his own locker for his clothes, and near the roof are arrangements for drying the washed working clothes.

The writer may here mention that eight hours working is now universal, and the men are given annually one week holiday, with full wages. Sunday working is not allowed more than every second Sunday; and then double wages are paid. Free beer and soda water are provided for the retort-house men. The men receive full wages during sickness and accidents, and after 25 years' service, in case of

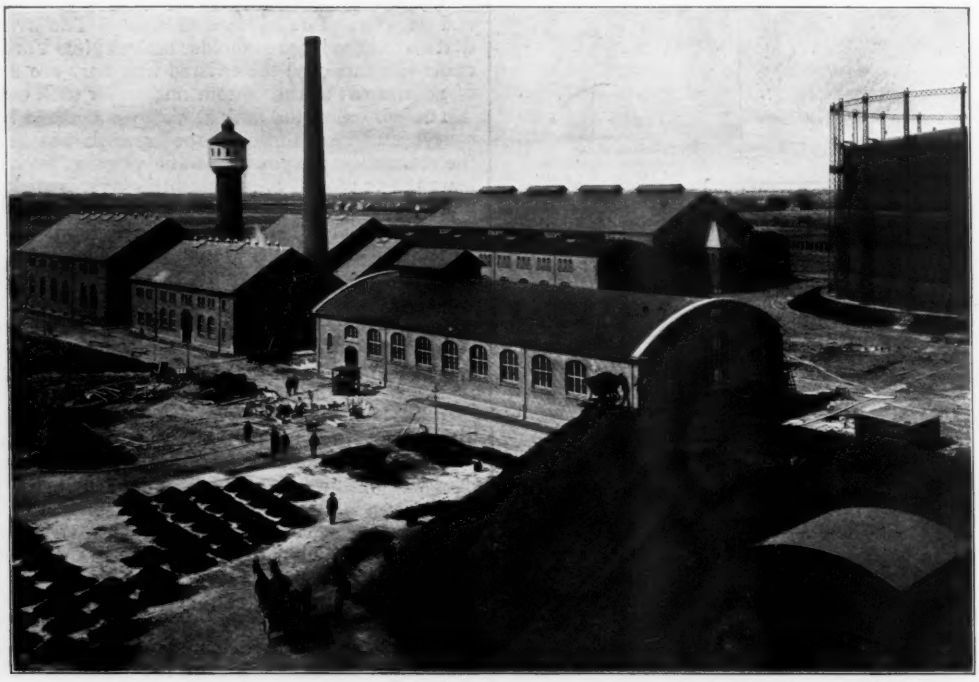


Fig. 13.—Bird's Eye View of the New Gas-Works at Copenhagen.

weakness, a pension equal to 66 per cent. of his wages is paid to every man.

Administration offices are built on each side of the entrance. The whole of the area is surrounded by a fence 7 feet high, the pillars of which are of reinforced concrete placed in a block of concrete, the other part being of wood. This construction looks well, and proves very strong.

The new works at Valby have cost complete about £320,000.

All the buildings are of red brick with some granite. Simple but tasteful forms have been used by the architect, who has worked in harmony with the engineers; effective and practical solutions resulting thereby. Buildings for manufacturing purposes need not be ugly. It must be possible in all cases to find something which, while meeting the engineer's requirements, also satisfies the eye. It may perhaps take some time to consider, but this is not lost; and it will often be found that such study will be of advantage to the whole arrangement generally, and in regard also to details.

Discussion.

Mr. J. F. Bell (Derby) said he must congratulate the author on the very admirable set of views he had prepared, and on the arrangement of the works. He was sure many would regret that Copenhagen was too far off to allow of their paying the works a visit. He thought the arrangement of the buildings was very happy, and showed just what was wanted in gas-works—good building space, but no extravagant ornamentation. One thing which had struck him was the large number of electric motors employed; and, as a gas engineer, he rather regretted that Mr. Irminger did not see his way to use gas-engines instead. He (Mr. Bell) had lately gone into this question with reference to some extensions, and found it was cheaper to put in gas-engines, with regard both to the first cost and to the attendance and running expenses. He knew that Mr. Irminger generated his current by a large gas-engine; but still it was a question with him (Mr. Bell) whether it would not have been cheaper, in certain cases, to have put down gas-engines in order to work the plant.

Mr. T. Canning (Newport) said he did not think it was a drawback, but, on the contrary, he considered it a very great advantage, to employ electric motors. No doubt there was a sentimental reason against it; but it was only sentimental. So long as they produced the current by gas-engines at a small central station, they could work more economically with electric motors. They had them at Newport—an electric capstan for bringing in coal from the railway, and electric motors driving the coal-breaker, the crane for tipping the waggons, for the conveyors and elevators, and for taking out the coke. If they had to place gas-engines where these motors were fitted, it would be exceedingly inconvenient. Take, for example, the motors employed in connection with conveying the coal across the retort-benches. They were best placed above; and this would be a very awkward position for gas-engines. Besides that, whatever might be saved in the capital cost would be swallowed up a good many times in the greater expense for attendance. He could see no reason against employing electric motors on the ground of economy; and he thought the only objection to them was more sentimental than anything else. They generated the current very cheaply—not quite so cheaply, probably, as it was produced at their central station, but at a fourth the cost at which they could obtain it from the power station. So long as there was a good load on, they could produce their current very cheaply; and they also set a very good example. When those who came to visit the works saw how cheaply and regularly the current was produced by gas-engines, they were inclined to adopt a similar method. The engines at Newport were so arranged that a very cheap gas could be used, if desired; but in the long run he had found it more economical, in using a gas-engine for generating current, to employ the gas as it was produced from the works. He thanked the author for giving so excellent and comprehensive a description of the works he had constructed, which certainly did him and his undertaking great credit.

The President said the members must all realize that, while the paper was an exceedingly valuable one for reference purposes, and would be of immense assistance to any engineer who was designing new works, it was not, perhaps, one which lent itself to extended criticism. They must, however, all feel indebted to Mr. Irminger for coming all the way from Copenhagen to give them so excellent a paper—showing them that the practice there was equal, if not superior, to the usual practice in England.

Mr. S. Y. Shoubridge said he should be glad if Mr. Irminger would tell them how it was that, in designing these complete new works so recently, he did not adopt the vertical retort system, because he (Mr. Shoubridge) felt sure he must have given it careful consideration.

Mr. Irminger, in reply, said they used horizontal retorts. The plans were prepared three or four years ago, when the vertical system was not very complete; so that he had not the courage to adopt it. In regard to the question of using electric power, he agreed with what Mr. Canning had said, and need not add anything to it. The special advantage of it was that the motors could be worked by common labour, special engineering attendance not being required. If they had gas-engines, it was necessary to have an engineer for each motor; but electric motors could be operated by an ordinary workman, who could attend to many at once. If

THE CENTENARY AIR GAS PLANT.

One self-contained, simple, and safe closed vessel, having only one movement.

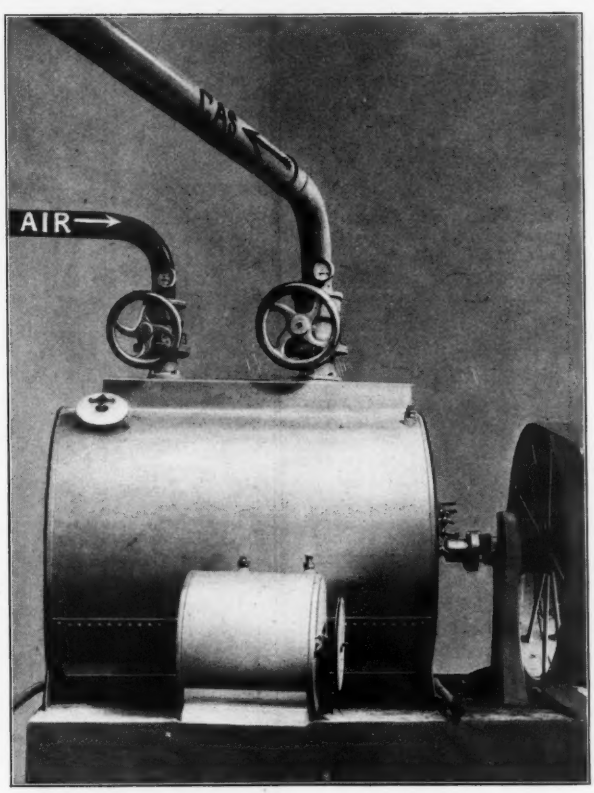
The acme of engineering effort to give the best and cheapest Gas Apparatus, and now introduced to consumers on the CENTENARY of the first lighting of public thoroughfares by its prototype, Coal Gas,

100 YEARS AGO.

The Illustration shows Machine capable of giving 20,000-Candle Power for 15 hours without refilling Petrol Reservoir.

Small Machine 500-Candle Power per Hour.

1000 Cubic feet of Gas for One Shilling.



Prices,

Including Weights or other driving power.

7 cubic feet per hour = 1 Light.

10	Lights ...	£25
20	,, ...	£35
40	,, ...	£47
100	,, ...	£120
200	,, ...	£175
400	,, ...	£250

20,000-Candle Power at 2s. per hour for Petrol.

For Villages, Rising Districts where expense for Gas Mains from nearest Town would be prohibitive, Factories, Mansions, Hotels, Churches, Schools, and Greenhouses. Air Gas does not injure Plants.

Can be fitted as a cheap auxiliary to Electric Lighting plants which have become too small, and to extend them would cost several times over the price of a CENTENARY Air Gas Installation, the light from which costs only $\frac{1}{7}$th that of Incandescent Electric Lighting.

The Gas is permanent, no Condensation, even through miles of Underground Mains, not even in severe frosty weather.

The Petrol Feed is adjustable to the atmospheric temperatures.

THE CENTENARY GAS CO.,

11, Queen Victoria Street, LONDON, E.C.

Central Chambers, 109, Hope Street, GLASGOW.

Telegrams: "CENTENARY GLASGOW," "VENTIDUCT LONDON."

A FEW AGENTS WANTED.

Our New Show-Rooms.

(See page 573 of the "JOURNAL" for the 2nd of June.)

CANNON IRON FOUNDRIES, LIMITED,

Works: DEEPFIELDS, near BILSTON, STAFFS.

they had three shifts, the labour question made a very great difference; otherwise he should say that the electric current was no cheaper than gas-engines. It was simply a question of attendance. He thanked the President and the members for their kind expressions, and assured them it was a great pleasure to him to come to the meeting and read the paper.

EXTRACTION OF CYANIDES AND MANUFACTURE OF YELLOW PRUSSIATE BY THE DAVIS-NEILL PROCESS AT THE LINACRE GAS-WORKS, LIVERPOOL.

By EDWARD ALLEN, of Liverpool.

While the presence of cyanogen in coal gas is objectionable, the percentage is so insignificant as to make its removal for that reason a matter of indifference. When it became known, however, that it was a valuable bye-product, considerable interest was taken in the subject. It is eleven years since Mr. G. P. Lewis read his paper entitled "Notes on Cyanogen as a Gas-Works Residual." Mr. Corbet Woodall presided on that occasion; and it is interesting to note that amongst those who took part in the discussion

Fig. 1.—The "Standard" Washer Employed—Showing a Brush in Position.

were Mr. Charles Hunt and Dr. Colman, who still contribute so much from their stores of valuable knowledge and experience to the proceedings of the Institution, and the late Mr. W. Foulis, of Glasgow, who was a pioneer in this as in other branches of gas engineering. There is much interesting reading in Mr. Lewis's paper; but considerable progress has been made since then.

Before dealing with the special process referred to in the title of this paper, it may be of interest to refer to various purposes for which cyanides are required. Prussiates of soda and potash have a fairly extensive use in various markets, both at home and abroad. Prussiate of potash has for many years been employed by dyers; but the cheaper prussiate of soda in recent years has been more largely used as a necessary and useful reagent with some of the coal-tar colours employed in textile dyeing and printing. Prussiates are also employed for the production of prussian blue, china blue, and other pigments. Prussiate of soda is extensively made use of for conversion into cyanide of sodium, which is employed on a large scale for gold extraction. Gold in a very fine state of division, which could not be obtained by the ordinary process of "washing," is laid hold of by the chemical action of the cyanide of sodium.

The older processes of prussiate manufacture from horn, leather waste, or other nitrogenous raw materials, are now almost extinct, and cannot be carried on to compete in cost with the product from gas-works. In addition, however, it is being produced by direct synthetic processes; so that

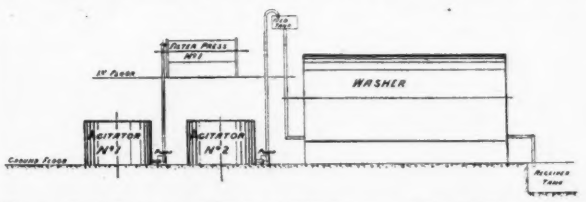


Fig. 2.—Part Diagram of "Davis-Neill" Process of Cyanide Recovery at Linacre, Liverpool.

while there is an increased demand for this material year by year, it has hardly kept pace with the supply. At present, in common with the general shrinkage of demand for all manufactured products, the sale of prussiate has met with a check, especially in the American markets; and prices are consequently at a low level. It is more than ever necessary, therefore, that in considering the adoption of a process, careful attention be given to the question whether it is worth while adopting a cyanide plant at all, and, if so, which process offers the greatest advantage in efficiency and economy.

It is with the object of giving assistance to the members of the Institution on these points that this paper offers an account of one, and that the most recent, process.

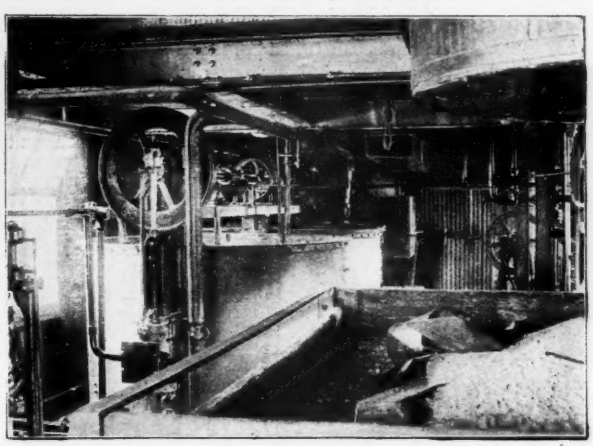


Fig. 4.—Nos. 1 and 2 Agitators for Mixing the Solution to be Put in the Washer.

Messrs. W. Neill and Son approached the Liverpool Gas Company with reference to the adoption of the process;* and eventually they offered to provide and erect a plant at the Linacre station, and work the process at their own cost—making a payment to the Company of a certain sum for each ton of coal used in the manufacture of the gas from which cyanides were extracted. The Company were to allow the existing "Standard" washers to be used by the contractors, and provide a building for the accommodation

* The author explained that the patents in the process were now being worked by Messrs. John Swallow and Co., of St. Helens.

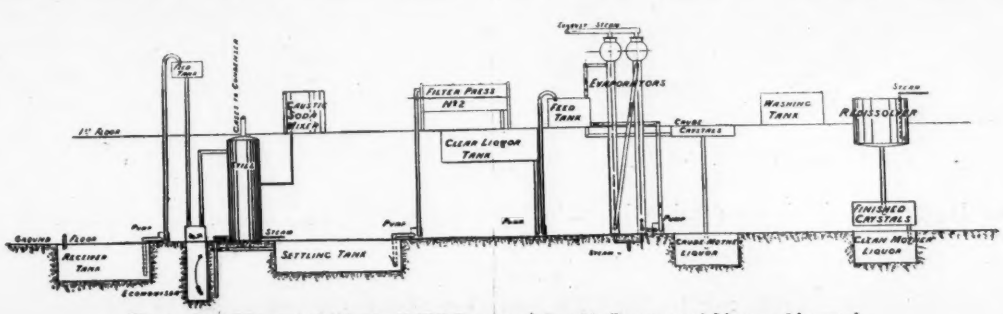


Fig. 3.—Part Diagram of "Davis-Neill" Process of Cyanide Recovery at Linacre, Liverpool.

of the plant. If in the opinion of the Company's engineer the process was found to be objectionable, or the arrangement unsatisfactory, the contractors agreed to cease operations and remove the plant at their own cost. But if, on the other hand, the Company were satisfied and decided to acquire the plant, it was agreed that they could do so on

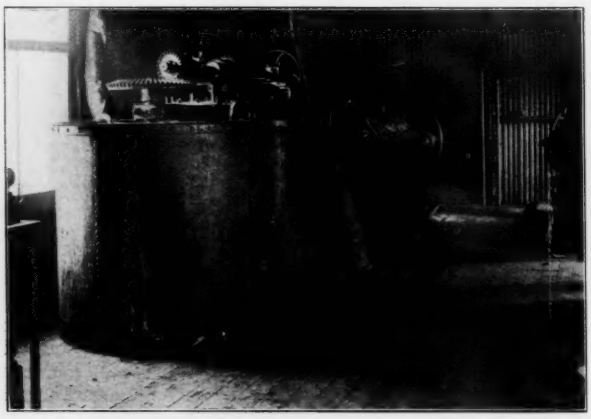


Fig. 5.—Nos. 3 and 4 Agitators for Mixing Caustic Soda.

payment of a stated sum at any time during the period of four years from the date of the agreement. The proposal was accepted, and the plant set to work in April, 1905. After a period of twenty months, the results were found to be so satisfactory that the plant was taken over by the Gas Company on the terms arranged.

Subsequently the shaft of the "Standard" washer broke, and the opportunity was taken to substitute Holmes' brushes for the original bundles of thin steel plates, and thus increase the effectiveness of the washer to extract the cyanides. A further alteration was made by dispensing with the Cochran portable boiler, and taking a supply of steam from an adjacent range of boilers with surplus power. The capacity

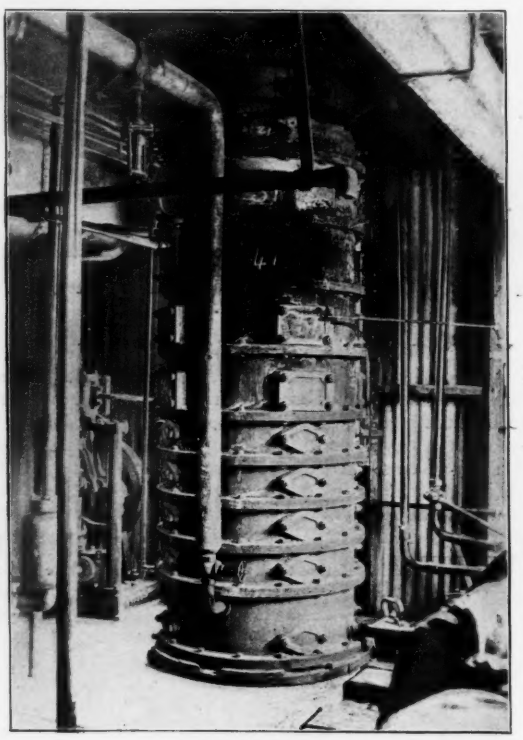


Fig. 6.—The Still Employed.

of the cyanide plant may be taken as equal to the treatment of 3 million cubic feet of gas, or about 270 tons of coal per day. It is erected in the south section of the works, and during the winter deals with the gas made by that section. But when the output is reduced, a supplementary supply of gas is taken from the north section; and the plant is thus kept fully employed during the whole year. This is a method only possible in large works, and is of very great economic advantage.

General Description of the Process.

The accompanying diagrams have been prepared to assist in the description of the process; and for this purpose the

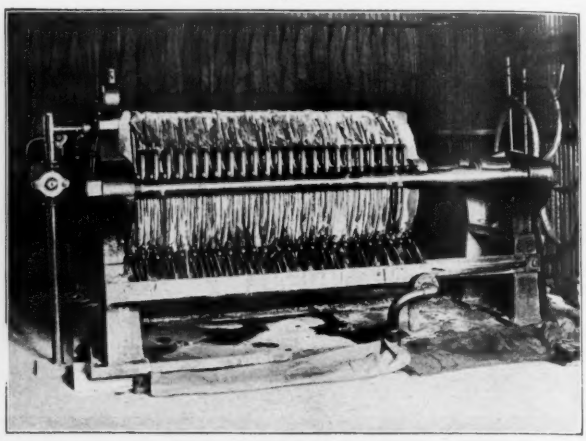


Fig. 7.—No. 2 Filter Press.

various parts of the plant are taken out of their actual and placed in relative positions. The photographs of different parts of the plant were taken on the spot; and an examination of them will afford the nearest approach to an inspection of the plant itself.

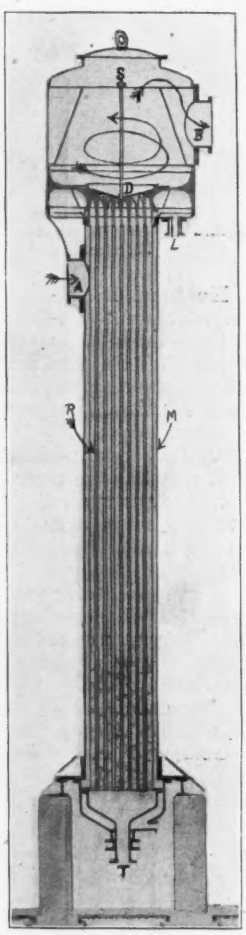


Fig. 8.
Section of the "Kestner" Evaporator for the Cyanide Plant at Linacre, Liverpool.

Preparation of Mixture for Use in "Standard" Washer.—The mixture required to extract cyanides from the gas consists of ferrous carbonate and soda. The former is obtained

by mixing copperas ($Fe\,SO_4$) with soda ash ($Na_2\,CO_3$), and is carrried out in No. 1 agitator, where 1 ton of copperas and 8 cwt. of soda ash, with sufficient cold water to make 180 cubic feet, are mixed together for about three hours, and allowed to stand for a day. After being mixed again for a short period, the contents are pumped to No. 1 filter press. The reaction is as follows: $Fe\,SO_4 + Na_2\,CO_3 = Fe\,CO_3 + Na_2\,SO_4$.

The ferrous carbonate is retained as cakes in the press; and clean water is passed through it to remove the impurities. The press, which, if in good condition, holds 21 cakes, should be charged in two to three hours, and the washing should be done in six to eight hours. The cakes weigh 78 lbs. each. Seven of them are placed in No. 2 agitator with 400 lbs. of soda ash; and the mud (FeS) from No. 2 filter press (referred to later), together with cold water to make up 200 cubic feet, are mixed for two hours, after which the contents are run into the receiving tank below.

It may be remarked that the ferrous carbonate is used in the proportion of 3 to 4 lbs. of copperas per ton of coal carbonized. The total iron is not less than 6 lbs. to each cubic foot of the cream in No. 2 agitator; but these proportions will depend on the type and efficiency of the washer employed. The cream contains enough soda to give an excess

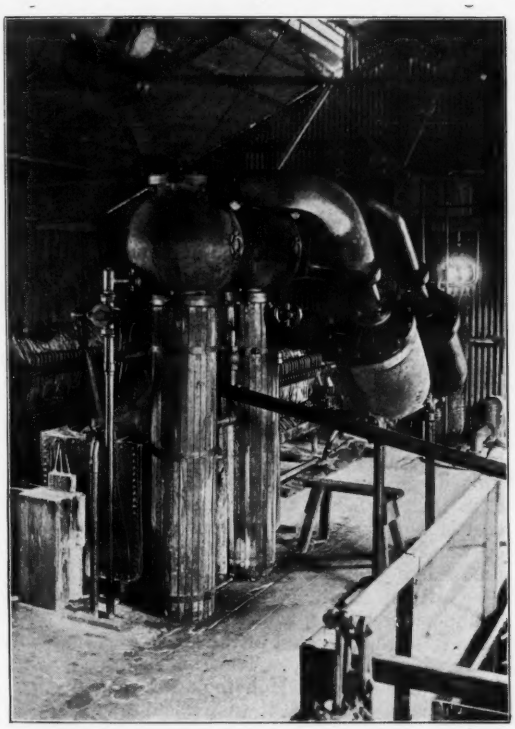


Fig. 9.—The "Kestner" Evaporators.

of 3 to 5 oz. per cubic foot of the still liquor, and is pumped from the receiving tank into the "Standard" washer at intervals of four hours. The contents (200 cubic feet) are divided into six operations during the twenty-four hours. The reaction which takes place in the washer is as follows: The ferrous carbonate is converted into ferrous sulphide by the sulphuretted hydrogen present in the gas; and the hydrocyanic acid in the gas then acts on the ferrous sulphide in presence of sodium carbonate and forms sodium ferrocyanide, the equation being $Fe\,S + 2\,Na_2CO_3 + 6\,H\,Cy = Na_4\,Fe\,Cy_6 + H_2S + 2\,CO_2 + 2\,H_2O$. Smaller quantities of insoluble double ferrocyanide of iron with sodium and ammonium are also formed.

Treatment of the Liquor from the "Standard" Washer.—The liquor, which is drawn off once a day, consists chiefly of prussiate of soda, ammonium-ferrous-ferro cyanide or insoluble prussiate, also excess of iron (Fe S), sodium carbonate, and ammonium carbonate. There are also other ammoniacal compounds, together with free ammonia and sulphuretted hydrogen, afterwards driven off in the still. The quantity of prussiate in the liquor is from 80 to 90 oz. to the cubic foot. From the "Standard" washer the liquor flows by gravity into a tank, from which it is raised into the economizer feed tank above. It then passes down through the economizer (heated by the hot effluent from the still) and up to the second tray of the still, and then descends through the different trays into the still receiver tank. At a point about half-way down the still, a strong solution of caustic soda is very slowly passed in (trickled) all the time the still is at work, so as to act upon

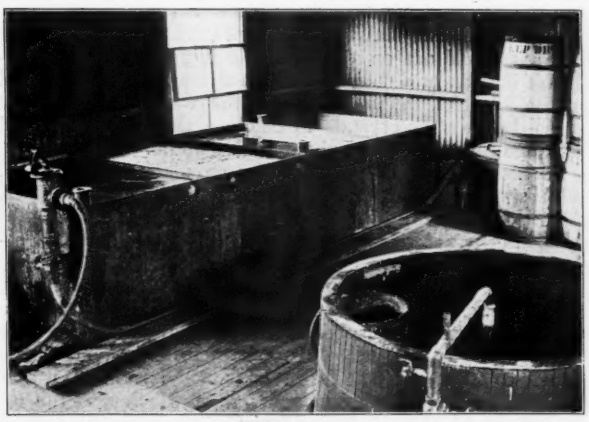


Fig. 10.—The Re-Dissolver and Washing Tanks for Washing Crude Crystals.

the sodium salt (sodium-ferrous-ferro cyanide) and form sodium ferro cyanide and ferrous oxide. $[Na_2\,Fe\,(FeCy_6) + 2\,Na\,HO = Na_4\,Fe\,Cy_6 + Fe\,O\,(H_2\,O)]$. The liquor from the still runs into a tank, from which it is pumped into, and through, No. 2 filter press.

The mud which is retained is iron sulphide (Fe S), and is used (as previously stated) again in No. 2 agitator to make up the cream for the washer. The clear liquor from No. 2 press contains the soluble prussiate of soda and a working excess of carbonate of soda, and runs into a tank situated below the press which is heated by a coil of ten 8 feet lengths of 4½-inch pipes, through which passes exhaust steam from the evaporators. From the tank, the clear liquor passes to the Kestner evaporators, of which there are two, capable of being worked together in series, or in parallel; the former being the usual course. Each evaporator consists of a shell containing nineteen thin steel tubes, 14 ft. 9 in. long and 1¼ inches in diameter. Steam is passed in at the top of the first effect, and is continued through the second one, then through a coil in the clear-liquor tank before being passed out into the air. The liquor is pumped into the bottom of the first shell, up through the tubes to the top, where it strikes a fan arrangement contained in a spherical chamber, is thrown out to the sides and runs down a pipe to the bottom of the second shell, in which the treatment is repeated, and is delivered into a feed tank on the first floor. The liquor circulates through this apparatus

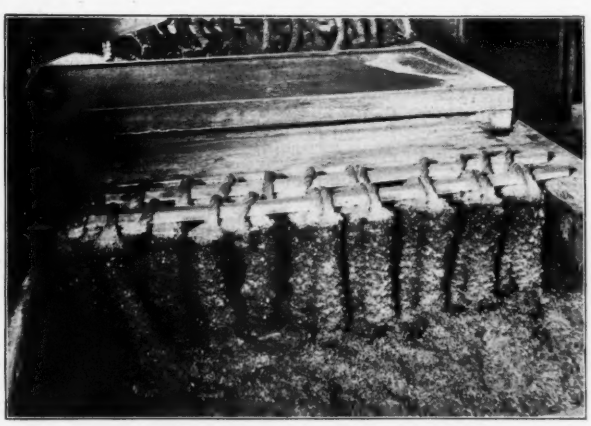


Fig. 11.—Finished Crystallizing-Tanks.

over and over again until, by evaporation, it reaches a density of 55° Twaddel; and then it is run into the crude crystallizing pans, which are three in number.

On being left to cool, fine crystals of prussiate of soda quickly form; and the remaining liquor is run off into the crude mother-liquor well. The crystals are thrown to the

back of the pans, the bottoms of which slope from front to back to permit of the liquor being drawn off. After about twelve hours, the crude crystals are removed to one of the four washing tanks, each 6 feet by 4 feet by 3 feet deep, and containing a false bottom of canvas-covered plates, 4 inches deep. The crystals are washed at least three times with mother liquor from the finished crystallizing tanks; the chief impurities removed being soda and sulphocyanide of sodium. The crystals must be kept covered with liquor, or the air would act on the insoluble impurities (chiefly sulphide of iron or a double sulphide of iron and sodium) and cause trouble. When a test of the washing liquor last passed shows the crystals to be clean, the tank is pumped dry and left to drain for about twelve hours.

Re-Dissolver.—This consists of a circular pan, 5 ft. 3 in. diameter and 4 ft. 6 in. deep, containing four steam-pipes, forming a cross and lying on the bottom. Small holes are drilled in one side of each arm, so that when steam is passing a circular motion is given to the contents of the pan. Fitted to the side of the pan is a cage of perforated metal, semi-circular in plan and extending the full depth. The washed crystals are placed in the cage and water or pure mother liquor is used to dissolve them and to bring the liquor to 46° Twaddel. It is then boiled for one hour and allowed to settle for fifteen hours, after which it is run off into the finished crystallizing tanks. These vessels, four in number, are each 6 feet square by 2 ft. 3 in. deep, and are constructed of wood, lined with lead. Across the tanks are placed laths of wood, from which pieces of rope are suspended to carry the prussiate crystals. As soon as the liquor from the re-dissolver is run into the tanks, canvas-covered frames are used to form a top and to prevent rapid cooling. It may be remarked that the effect of rapid cooling is to throw down smaller crystals than are desirable.

The crystallization is allowed to proceed for about fourteen days, after which the pure mother liquor is run off into a well and used, as before stated, to wash the crude crystals. The draining and drying of the crystals occupy about eighteen hours, before the ropes are removed. A considerable quantity of crystals are also taken from the sides and bottom of the tanks. When quite dry, the crystals from the ropes and the tank are packed in strong wooden casks lined with brown paper, and holding about 5 cwt. In this condition they are ready to be sent to the ends of the earth.

It cannot be said that the present state of the market encourages the adoption of cyanide plants on gas-works. It is evident that the supply of prussiate exceeds the demand; and the right policy appears to be restriction until the balance is adjusted. But when this time arrives, the claims of the Davis-Neill process will undoubtedly repay close consideration.

Discussion.

Mr. D. Irving (Bristol) said they were all much indebted to Mr. Allen for his paper. The chemical reactions he had described, and the mechanical arrangements, seemed all very satisfactory; but the thing which would have been of greatest interest to himself, and probably to many others, had been omitted. The President, in his address, spoke of the difficulty of obtaining reliable information as to the cost of the recovery of cyanide; and this was, perhaps, the most interesting aspect of the subject. No doubt Mr. Allen had very good reasons for not dealing with the cost of the plant, or of the production of this yellow prussiate; but he would suggest to him that it detracted very much from the value of the paper. If he were at liberty to supply this information, he would put the members under an additional debt of gratitude.

Mr. J. H. Brearley (Longwood) said that Mr. Irving had made the request which he had intended to make, because the paper would have been more valuable if there had been a table showing the cost of the plant, the cost of production, the profit made, and the average amount of sodium prussiate obtained over a definite period. The author said that the older processes of prussiate manufacture from horn, &c., had become almost extinct. He (Mr. Brearley) had been given to understand that the synthetic method of production cost something like £30 per ton; yet Mr. Allen told them that a considerable amount of prussiate was still produced by this method. If, as he had seen in the Technical Press, the cost of the process Mr. Allen had described was only £10 per ton, it seemed to him that there was still a field for sodium prussiate manufacture in gas-works by displacing the synthetic process. He should therefore like Mr. Allen to give them some figures as to the exact cost per ton of producing sodium prussiate by this method at Liverpool, and also tell them whether he had made any inquiries as to the cost of production by the synthetic process. Such information would be a valuable guide to members who might be considering the possibility of adding to their gas-works profits by producing sodium prussiate.

Mr. J. F. Bell (Derby) said all would agree that any figures given by Mr. Allen might be accepted without question; but he felt himself that the experience financially of those who had gone in for cyanide recovery during recent years had not been an altogether happy one. Mr. Allen emphasized this two or three times, and told them the supply had overtaken the demand. At Liverpool, they were working under ideal conditions. They had a plant which could deal with the gas produced from 270 tons of coal per diem from one section of the works; and when this section was not fully employed, they could divert the gas from another section, and could therefore always work the plant to its full capacity. There were not many engineers in such a favourable condition. Two years ago, when he visited this plant, he was very much struck by it. He found the crystals produced were excellent, and the process seemed to be exceedingly good. The price of prussiate of soda was then about £45 per ton; but to-day it was something like £28, and difficult to sell even at that price. There was therefore a difference of £17 per ton, representing a very handsome profit; so that now one might be working the plant on a very bare margin. He found that the price of prussiate in 1904 was 4d. per pound; in 1907, it was 4¾d.; and to-day it was in the neighbourhood of 3d. He believed contracts had been entered into for sales over the next year for just about 3d. He had been working this Davis-Neill process for something like nine months, but was not prepared to give figures. They had had certain difficulties with the process, not with the prussiate plant, but more especially with the washer. The sulphide mud wanted to be brought into very intimate connection with the gas, about which there was a difficulty; and the result was that they had not been able to extract the whole of the prussiate from the gas. Though the process was a good one, there were certain defects, one being the large amount of sodium carbonate used in the extraction. Another was that they were not able to get the whole of the prussiate in a saleable form. Of course, the sodium carbonate which was put in the cyanide washer was decomposed, and the carbonic acid was mixed with the foul gas, and had to be taken out later either in the purifiers or in the ammonia. With regard to the cost of manufacture being about £10 per ton, his experience was that it was considerably more—he should put it as more like £15, or about 1½d. per pound. Then there was the interest on the capital outlay and depreciation of plant, and other things, which would amount to about 1d. per pound; so that the cost of the prussiate, roughly speaking, was 2½d. per pound. The selling price to-day was somewhere about 3d., which included carriage, packing, and other charges; so that it was evident that the profit was very small. He noticed that Mr. Allen in preparing the sulphide mud, used sodium carbonate. They took copperas and dissolved it, and then used ammoniacal liquor. The sulphate liquor obtained they put in the saturator, and distilled afterwards. He must again thank the author for his valuable and fair contribution. Of course, it was nice to be able to give one's fellow members an account of successes obtained; but sometimes processes when first introduced were not altogether what they should be, and they ought to have the courage to mention the disadvantages as well as the advantages.

Dr. H. G. Colman said this paper was of very great interest to those who had had anything to do with cyanogen recovery, and also to everybody else, if they could only know just how much money could be made out of it. He would try to deal shortly with both sides of the question. In the first place, he had had the pleasure of seeing the plant at Linacre, and certainly the arrangements were exceedingly good, so far as the chemical works portion of the plant was concerned; but as Mr. Bell had already stated, the great difficulty in cyanide recovery lay in the washer, and the difficulties that had occurred were often due to the fact that the washer had broken down and one could not treat the gas for considerable periods of time. The principles of the Davis-Neill process were, of course, practically the same as those of all the other prussiate processes which had been adopted in various works. They all depended

upon the reaction which was described by Liebig more than sixty years ago, when he showed that hydrocyanic acid was absorbed by a mixture of an alkali and iron salt, with formation of the prussiate of the alkali used. The Davis-Neill process more or less occupied an intermediate position between the well-known processes of Rowland and Bueb on the one hand, and those of Knublauch and Foulis on the other. In the first named an iron salt was added to the gas before removing the ammonia; the ammonia itself supplying the necessary alkali. The result was that the prussiates produced were mainly or entirely insoluble, and were then filtered off, and worked up into soluble salts. In the second class, the ammonia was first removed, and with the iron salt was added soda to supply the necessary alkali. In that case, the chief product was soluble prussiate of soda, with only small quantities of insoluble prussiates. Messrs. Davis and Neill treated the gas before removing the ammonia, but also added soda, so that they obtained as a resulting product a solution of sodium prussiate, with a fair amount of insoluble prussiates in the liquor. These last, however, were converted into soluble prussiates in the subsequent process of distillation which was necessary to recover the ammonia, by means of adding a little caustic soda to the contents of the still. Now the advantage of treating the gas before the removal of the ammonia lay in the fact that, in the removal of the ammonia in the washer, some of the cyanide was also removed in the form of sulphocyanide and lost. Therefore by treating the gas before the removal, one had a larger amount of cyanide in the gas. On the other hand, when there was ammonia present in the cyanide washer, a much larger proportion of cyanogen in the gas was converted into sulphocyanide instead of into prussiate, which was, of course, wasted in the mother liquor. Again, when distilling off the ammonia from this solution containing the ammonia, sodium sulphide, sodium carbonate, and prussiate, a further quantity of prussiate was converted into sulphocyanide and thus lost. The amounts so produced varied at different works, and even in the same works. He had often found that the extra amount of sulphocyanide lost by treating the gas before removing the ammonia was as much as, and sometimes more than, that lost when the ammonia was previously removed. At Birmingham, where for special reasons it was not possible to treat the gas before the ammonia had been removed, a modification of the Knublauch process was adopted, in which lime was used as the alkali, instead of soda. The result was a solution of calcium prussiate, which was converted into sodium prussiate by exact precipitation with soda. The advantages were that, in the first place, considerable economy in soda resulted, because all the waste of alkali took place in the cheaper lime, and not in the more expensive soda. Another advantage was that the solution obtained was very much purer, and it was possible, with suitable working, to obtain by the first crystallization a commercially pure product which could be sold direct. The disadvantages lay in the trouble already mentioned—with the washer. The lime being but sparingly soluble in water, the mixture became much thicker owing to the presence of the suspended lime, and mechanical troubles continually occurred. He believed that these troubles would be much obviated by the use of the Feld washer, to which the President referred in his address, and with which he (the speaker) was much struck when he first saw the drawings. He believed it was in the first place designed for dealing with thick materials, such as the cream used in a cyanogen washer; and his favourable opinion of it had not been decreased since he had seen it at work in Germany. Coming back for a moment to the question of the prussiate market, Mr. Allen, both at the beginning and the end of his paper, gave a caution—with which he (the speaker) fully agreed. When the matter last came before the Institution, some eleven years ago, the price of prussiate was about 5d. per pound. It soon dropped to about 4¼d.; and since then, with the exception of a few months, it had steadily fallen, until it was now 3d., or a little under. The total production of prussiate at the present time was already far in excess of the total world's demand for prussiate as such; and the surplus had to go for the manufacture of cyanide, for which there was a much larger demand. But here the prussiate came into competition with other methods of producing cyanide—such, for example, as its production from beet-root molasses (in which Dr. Bueb, now so well known in connection with vertical retorts, scored his first success), also its direct production from ammonia, and further from sulphocyanides, these themselves being obtained by another process, chiefly from gas-works. If any considerably increased quantity of prussiate was to be put upon the market, unless there were simultaneously an increased demand, the price must inevitably be still further reduced; and the margin of profit available, which was at present very limited, would be smaller than ever, and would be not unlikely to disappear. So that any fresh individuals starting to recover prussiate might not only do themselves no good, but might also do considerable harm to others already engaged in the manufacture. As to the cost of production, to which the President, Mr. Irving, and others had referred, both the reasons given in the President's Address for the non-publication of figures were true. With plant of this sort in a gas-works, mixed up with many other processes, it was no easy matter to accurately dissect the accounts so as to ascertain the exact cost of production. On the other hand, the production of prussiate was, unlike most other things which occurred in gas-works, a wholly competitive matter, even as concerned other gas companies. For this reason, permission to publish the figures of cost was usually not given; and they would all understand why this was. He could give some approximate costs from various sources; but under the circumstances he did not feel at liberty to do so. One thing might be taken as certain—that with this prussiate process it was not possible to make at the present time any very considerable sum of money, certainly not one that was going to reduce the price of gas by an appreciable fraction of a penny.

Mr. Alex. Wilson (Glasgow) said, as they all knew, they had been making cyanide in Glasgow for a considerable time by what they called the "Glasgow Process." They did not go to the same extent as Mr. Allen did, because they only made what they called cyanide cake. They did not for several reasons crystallize the product. The main reason was that at the beginning they were rather limited for room at the works at Dawsholm; and they thought that if they could get a good outlet for the cake, it would be to their advantage to sell it in that form without doing anything further. They tried the crystallizing process on a small scale, but found it was going to take up so much room and attention that they decided to continue manufacturing the cake as it came from the pans. Mr. Allen, of course, had gone a good deal farther than this; so that the processes were not quite comparable. Their process at Glasgow had now got crystallized into part of the works; and the whole thing went on from day to day without any trouble at all. It was placed in the hands of one of the assistants in the laboratory—in fact, a mere lad—and the work all through was done by labourers, so that there was no great expense in this direction. Another point was that they started in this business early. They paid off the whole of the capital cost of the plant in the first year's working, so that in taking into consideration the cost of working now they were in the happy position of only having to charge the labour cost against the product. The paragraph at the end of the paper about restricting the output of cyanide on general principles, was a very good one; but there was another side to the question. They knew that there were other methods of producing cyanide; and some of these methods were still making a profit. So long as they were making a profit, why should they stop, or even refrain from extending their operations? If they could get their works into going order when the market was fairly good, and could make a profit, they were entitled to go on; otherwise other people would extend their works, and presently there would be no chance for them at all. He had taken this matter into consideration several times, as they had a pretty large output; and he came to the conclusion that if he stopped making, other folks near him—particularly the Cassels Gold Extraction Company—would immediately extend their plant, and he would never get in again. He had a very good market at present, and proposed to keep it. At Glasgow they worked with fairly high heats. A large proportion of their carbonizing was done with three-hour charges; and they found that with these charges they obtained much better results than they did when they worked four-hour charges. They got from 25 to 30 per cent. more cyanide from the same coal carbonized for three hours than with four-hour charges. Carrying this out to its logical conclusion, he thought that under the new vertical retort system there would not be any need to put down a cyanide plant. Their average output of cyanide cake at Glasgow ran up to about 5 lbs. per ton of coal carbonized. The whole of the plant ran with practically very little attention; and they

had had no difficulties whatever with the washer. They used the Holmes brush scrubber. At the beginning they had a little trouble; but he could safely say that once the washers were put in good working order, and had a proper system of lubrication of the bearings, they had had no trouble. The washers were seldom cleaned out, but worked practically all through the season. They did not extract the cyanide from all the gas made in the winter time, but preferred keeping the plant going regularly all through the year, as regular work tended to economy. In one works they could practically deal with all the winter's make, but in the others they only dealt with about 75 per cent. The process Mr. Allen had described, of going on to the crystallizing, added a great deal to the cost; and it occurred to him that this might be better done on a large scale by other people outside. He thought that by selling the cyanide in the form of cake they could get perhaps a better price for the product. While it might not be advantageous for other people to put down plant at the present time—it was a matter for themselves—he was certainly of opinion that all those who were now producing cyanide should continue to do so.

Mr. P. S. Hoyte (Plymouth) said as his Company were the first to put this process into operation, and as at their works it got through most of its childish complaints—and there were a good many—he should like to make a few remarks. First, with regard to the working, he would ask Mr. Allen if he found it more economical to precipitate his mud with soda, instead of in the usual way with gas liquor. He had certainly found the precipitation with gas liquor was more economical than using soda. Another point with regard to the working was the use of the mud over again from the No. 2 press in the washer, which Mr. Allen apparently worked round and round again. He would ask when, if ever, he took it out of the process. They had tried it from time to time, but almost invariably found a falling off in the make resulted. The theory he formed was that the small particles of mud got a coating of tar on them in the process, which rendered them inefficient; so that when the mud reached the No. 2 press, they put it on one side, and let it oxidize in the air, mixed it with sawdust, and used it in the purifiers, where it acted very satisfactorily as a purifying agent. He entirely agreed with Dr. Colman as to the purely mechanical part of the extraction, particularly in the light of an unfortunate experience they once had—the only one in otherwise uniformly successful working. After the washer had been at work about three years, they had to renew the brushes; and he sent a sample of the brush to the makers, with instructions to forward precisely similar ones. They sent a set of brushes containing only about half the number of bristles as the sample, and the bristles were twice or three times as thick. The make of prussiate fell off to an extraordinary extent; and they had to take the brushes out, and substitute others exactly to the original pattern. They were now getting better results than they had ever done before—an extraction of about 3½ lbs. per ton of coal carbonized. Mr. Wilson looked forward to a happy time when they would be using vertical retorts, and there would be no cyanide produced from the gas. When this time came, it would certainly pay those who had cyanide plant to go on working. He could not conclude without paying a tribute to the late Mr. George Davis, the inventor of this process. Those who were brought in contact with him knew him as a most charming man, who combined an encyclopædic theoretical knowledge with the rare quality of being able to apply it to any problem that arose. His death in the prime of life was a loss not only to the gas engineering world, but to the chemical world generally.

Mr. Allen, in reply, said that, as he had expected, the discussion had been more interesting than the paper itself—as, in fact, the President had told him he anticipated. He thanked the various speakers for their kind remarks, and expressed the pleasure he had felt in preparing the paper. As he expected, the matter of cost was the special point raised. Mr. Irving at once, with his practical insight, put his finger upon it. This was not an ordinary process of gas manufacture, but a special process; and there was competition between those who were making prussiate. Therefore there were reasons from a business point of view why detailed figures should not be given. But he was glad to say that among gas engineers, if information was wanted privately, there was always a disposition to meet any such inquiries, and a desire on the part of those who had a process to help those who were asking about it. He was glad to say that he shielded himself behind his very able Chairman in not giving figures, because it was his Chairman's wish that they should not be given. Unfortunately, a statement did get into the Technical Press a few weeks ago, which had evidently met the eye of some speakers, and had been referred to by Mr. Brearley. The statement was not a terminological inexactitude, but it was altogether inexact. It represented the exuberance of a reporter to a newspaper, who accompanied some gentlemen who desired information combined with pleasure on a visit to Liverpool; and he had ascribed the words of one gentleman to another gentleman. As a matter of fact, if he were to give the figures (which he had before him) showing the direct cost of every part of the process during a complete year, and during a recent period when they considered they had the most favourable conditions, the information would not be of much use of itself. In these matters the value of the information depended on the use made of it; the whole thing required explaining. The conditions under which he worked as compared with those under which others wanted to work might alter the whole aspect of the case. Speaking broadly, he did not think anybody could turn out prussiate under £20 per ton, even dealing with the concern in the most economical way; and when they could not get a sale for the prussiate they made to-day at 3d. a pound, but must be content with a figure that was something below that, they could see very well that the margin was too small to permit of anyone entering on a new process. Mr. Davis, the brother of the late Mr. George Davis, who had received a very well-earned tribute from Mr. Hoyte, was present, and had been good enough to provide him with information as to prices. Starting with 1899, there was a rapid increase in price, which went up to something like 6½d. a pound. It varied a little, and then dropped down in 1901 to 4d. It continued fairly good for a considerable period; but in 1906 there was a rapid advance again, and the figure reached 4¾d. At this time, he was glad to say, they sold a considerable quantity. Since then it had dropped; and the price shown him now was only about 3d., but it had really gone below this. In anybody would offer to buy from him to-day over the next six months at 3d., he should be glad to sell. Mr. Brearley put a question about the cost of the plant. He was glad to say that it had been practically paid off by his Company; but if anyone wished for further particulars, Messrs. John Swallow and Co., of St. Helens, would be delighted to give them. The synthetic process was referred to as costing £30 a ton; and a reference was made to the Technical Press which he had already answered. His opinion of the synthetic process was worth nothing, because he only knew what they all knew about it. It was a great pleasure to him to give Mr. Bell information, and as far as possible to assist him in getting his plant to work under the best possible conditions. As to the excessive amount of sodium carbonate, and not recovering the whole of the cyanide, he agreed with him. The reason they did not use ammonia liquor was that they had sold the whole of their liquor under a contract which extended over some years; and therefore they were not at liberty to make use of it for this process. The gas they treated had already been passed through the condensers, the scrubbers, and the Livesey washer before it reached the "Standard" washer, in which it was treated for the recovery of cyanogen. No doubt under other circumstances it would be cheaper to use ammoniacal liquor as the alkali, instead of soda. He must refer to the very great debt of gratitude they owed to Dr. Colman for the services he rendered them in this matter. Not being a chemist himself, his Directors authorized him to obtain expert assistance; and he was glad to find in Dr. Colman a man who understood the whole thing most thoroughly, and who gave such advice as had guided them in the matter. To anyone considering the question of this new process, he should say: "Go and do likewise." Mr. Wilson's references to the Glasgow process were very interesting. He (the speaker) had referred to Mr. Foulis's work in cyanide extraction years ago, and no doubt the process was working satisfactorily; but while Mr. Wilson had had no trouble or expense with his process, it almost sounded as if he thought that they had trouble and extra expense. However, thanks to the skill with which the plant was designed by the patentees and makers, it was worked in the most simple manner. They had merely labourers doing the work, with the help of one of their chemical assistants. Mr. Davis himself ran the plant for some months before they took it over, and thus enabled them to get it into good working order and to thoroughly understand the eccentricities which

every plant had. He also wished to say how very kind Mr. Hoyte and his Chairman were when he went to see them in the first place about the plant; and he was afraid the encouragement he received there was responsible for the competition at Liverpool. They did not intend, however, to cease working. They should go on as long as there was a margin between the selling price and the cost of manufacture. The limit had not yet been reached. They had practically paid off the cost, and were charging nothing against the process for capital; so that if anybody could make anything out of it, they were in that position. There was a final loss of ammonia in the process which he should estimate at about 6 to 7 per cent. The present amount of prussiate obtained per ton of coal carbonized was 3 lbs., which did not represent all of the cyanide in the gas, which was probably about 4½ lbs. The trouble with the washer in the first place, which was a great breakdown, led to the adoption of the Holmes brushes; and they had had no trouble since.

REFRACTORY MATERIAL.

By FREDERICK J. BYWATER, of Birmingham.

The absence from the "Transactions" of the Institution of any paper dealing with the subject of refractory material, and the general scarcity of technical literature on the question, would provide ample apology, were one needed, for bringing it forward for consideration.

The suitability of materials offered by manufacturers for use in the construction of retort-settings is one which comes up for decision annually, and its importance, which has never been under-estimated by gas engineers, is one which is increasing year by year. The causes of this are several. The introduction and improvement in the efficiency of gaseous firing have made higher temperatures of carbonization possible. These possibilities, coupled with the almost general reduction in illuminating power, have been taken advantage of by most engineers; and the average temperature of carbonization may now safely be stated to be at least 200° Fahr. higher than it was twenty years ago. This fact, together with the development of new carbonizing systems, particularly by that of inclined retorts, has caused more attention to be given to these matters, by reason of the greater demands made upon the materials of construction in retort settings.

Whether these demands have been adequately met by improvement in the quality of material, is a question of local rather than of general application, according to the source from which the refractory material is obtained. Yet, despite the fact that knowledge of the raw materials is, or should be, greater than it was twenty years ago, and that new and extensive sources of highly refractory material have been opened up during this period, it is a matter for very grave doubt whether, on the whole, the quality of fire-brick and retort material has generally improved.

Absolutely refractory material, in the true sense of the word, does not exist; the term refractory being merely a relative one, depending upon the process in which the material is to be employed. The subject is therefore one of exceedingly wide application, involving as it does material used in most metallurgical and chemical processes, each of which requires to be studied separately before a suitable material can be chosen.

To treat this question thoroughly, and in all its many and interesting phases, would be quite impossible and out of place here. The author therefore proposes to deal with it as it affects gas engineers only. It is not intended either to treat in detail the question of manufacture (which can be much better studied if required by a visit to an up-to-date works) or the very intricate chemical problems which present themselves for solution in studying the subject, and which properly belong to other circles; but rather to set forth the general principles underlying the composition and utility of the principal refractory agents employed in retort-settings, and indicate the lines on which it would appear that present-day requirements are likely to be most successfully met.

The chief sources of refractory material at present employed in the construction of retort-settings are: (1) Fire-clays. (2) Silicious quartz.

Origin of Fire-Clays.

The origin of fire-clays is a question around which much wordy warfare has been waged; but from the investigations of Bischof, Forchammer, and others, the origin of kaolin, or china clay, of which fire-clays are really an impure form, may be ascribed to the decomposition by weathering of felspar or minerals related to it.

By weathering is understood the process of destruction of a rock, in which, through external chemical and physical influences, a part of the substance is removed, and thereby a lessening of the cohesion is brought about; so that it is possible for mechanical forces to carry away the more or less changed residue and deposit it elsewhere to form new strata. This process of destruction of the rocks forming the earth's crust, by the influence of water in union with oxygen, carbonic acid, and change of temperature, is constantly going on, and causing at the same time new formations to appear. Owing, however, to the diversity of the chemical and physical properties of the masses subjected to change, and also to the fact that the destruction is so frequently modified by local conditions, a vast number of new forms arise, and offer such infinite difficulties to their consideration from common points of view, that science has not yet completely succeeded in bringing into this chaos that clearness which would enable industries to use readily, and with entire confidence, all the materials at disposal.

Only a few of the crystalline rocks can, from their chemical composition, produce clay on weathering; and rarely do the clay-forming rocks undergo the process of weathering to the last stage—the formation of true clay substance or kaolin—but remain more or less in the intermediate stage. Besides clay, therefore, there arise detritus, gravel, sand, loam, &c., or, if the process of weathering and destruction be interrupted, the original rocks may be reformed as sandstones, shales, &c., and perhaps crystalline rocks.

Felspars have been investigated very thoroughly with regard to the process of weathering, and although, by reason of the great resistance of crystalline rocks to the weak action of the forces at work, the weathering process occupies a very long time, and thereby makes difficult the study of the phases through which it runs, it is now possible to make a fairly accurate general statement as to what has taken place.

Felspar is not a single chemical compound, but a term used to denote a group of mineral silicates, with many varieties of similar composition. Probably the best known is orthoclase or potassium felspar, which would contain, when pure, 64·7 per cent. of silica, 18·3 per cent. of alumina, and 17 per cent. of potash. The potassium may, however, be partially or entirely replaced by any one of several other metals, such as sodium, calcium, and lime; and in each case the new mineral retains the family name of felspar. They may all be represented by the general formula,

$$RO\ Al_2O_3\ 6SiO_2,$$

where RO represents 1 molecule of oxide, similar to potash, soda, or lime, Al_2O_3 1 molecule of alumina, and $6SiO_2$ represents 6 molecules of silica.

The decomposition of the feldspathic constituent of crystalline rocks begins, as a rule, superficially, and shows itself in a dimming of the crystal surface. Under the microscope such a crystal in the first stage of weathering is seen to be traversed by numerous very fine cracks, more or less deep. When subjected to washing by rain water—*i.e.*, water with carbonic acid dissolved in it—the alkalis, lime, and silicic acid are carried away, and the mineral would suffer a loss of about 50 per cent. by weight and 33 per cent. by volume on being transformed into clay. This, on a small scale, is an example of what has taken place in the formation of fire-clays; the surfaces of huge masses of feldspathic rocks, subjected for centuries to the influence of weather—frost, snow, rain, and alternations of temperature—have been first of all broken up, and either converted into clay substance *in situ*, or more usually washed away and deposited elsewhere. After the completion of the weathering and washing process, which the original rocks from which clay has been derived undergo, the chemical effect of the water and atmospheric agencies does not cease. Further, weathering or lixiviation takes place; the formation of the clay substance being considerably assisted by the continual rubbing and breaking-up of the felspar granules against other and harder minerals in the presence of water—some of the substances being dissolved. And just as in the case of weathering we can follow the breaking-down of the crystalline rocks, so also, by an inverse metamorphosis and infiltration, we can pass from the detritus of the weathering process back again to the solid rocks, sandstones, &c., and also fire-clay seams.

Fig. 1.—Typical Chart of Stourbridge Seams.

Fig. 2.—Enlarged Section of Stourbridge Clay Seam.

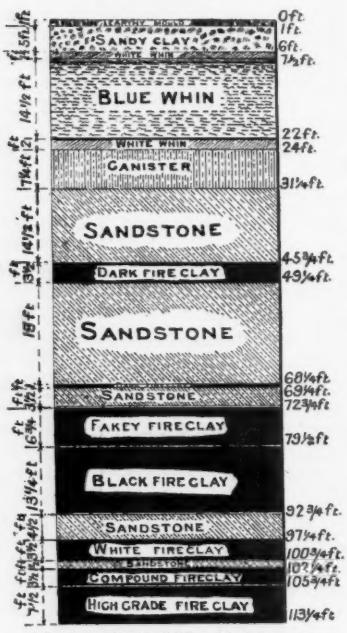


Fig. 3.—Chart of Fire-Clay Seams at Glenboig.

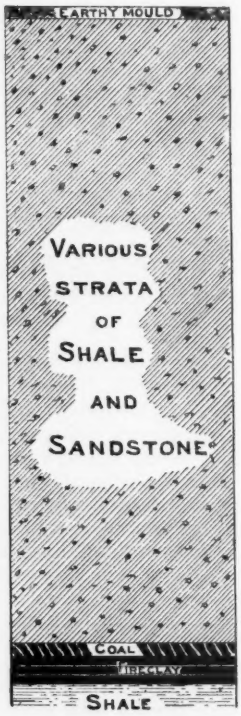


Fig. 4.—Chart of South Yorkshire Fire-Clay Seams.

Where the products of the weathering action are not washed away, but still remain on the same site, the original rocks, split up first of all into thin laminae, becoming thinner and thinner, again take, on re-formation, the structure of the rock from which they come, even though considerably distorted by loss of substance and volume. If however, in addition to the weathering, a washing has taken place, the structural relations of the clay become much different.

These sedimentary clay beds most frequently assume a horizontal parallel structure, caused by the presence of layers which are chemically and physically different to others near by; so that at different heights of the deposit or seam, sand, felspar, or clay predominates, which themselves are different with reference to grain and plasticity on the one hand, and, on the other, show difference in the mineral detritus—the crystalline residue appearing in extremely thin laminae, in which the weathering process has not progressed to the complete extraction of the alkalis, and the loss of crystalline texture always associated with it.

This is readily seen on reference to the large detailed cross section of the so-called Old Mine Seam of Stourbridge clay, which is fairly typical of such action. Here the "mild" clay, rich in alumina, predominates at the top of the seam, gradually changing to the "strong" or silicious clay at the bottom, with the "medium" clay in between. This "medium" strata usually contains the well-known Stourbridge "Pot" clay.

To what cause this stratification is due cannot be definitely stated, owing to lack of positive and comparative observations; but it may be said that the silicious crystalline strata are undoubtedly formed in agreement with the general law of crystal formation, and the action of water has been a very potent factor throughout.

When examined under the microscope, the strong clay is seen to consist of well-defined crystalline forms; the medium clay has some such crystals in a mass of fragmentary shapes; and the mild clay seems to be wholly made up of irregular forms of very fine particles of matter. It would appear that these latter have had their crystalline forms broken up by the washing and weathering, and the strong clays have not suffered in this way. The mild clays are more plastic, and make stronger and tougher bricks than the latter. In this there seems to be a close correspondence between fire-clays and many metals, notably iron, in which the tensile strength decreases as the crystallization increases.

With regard to the fire-clays of the coal measures, of which type there are many existing in this country, it would appear, from the stigmaria existing in some of them, that they were the original soils on which grew the vegetation that formed the coal; but they are not always associated together now. In some instances they occur in the coal itself, and in some apart, in which case the coal may have been eroded away, or may never have been formed. The growth of vegetation, and the leaching action of water generally associated with it, would undoubtedly remove some of the alkalis from the clay; and the carbonic acid resulting from its ultimate decay would materially assist in the removal of impurities. The dark grey colour of the coal measure clays is due to minute particles of organic matter disseminated throughout the clay by the action of water; and the other colorations—blue, black, red, &c.—that occur are due to mineral impurities.

Composition of Fire-Clays.

Having now traced their origin, it is possible to proceed to discuss the chemical and physical composition of fire-

clays. It will be understood that in the washing and weathering which gives them origin, the clay products must lose a considerable amount of the alkali molecule originally present; and where the weathering of the original feldspathic rock has been complete, kaolins are formed, and fire-clays result where the weathering has been incomplete or interrupted. Kaolin may be represented by the formula:

$$Al_2O_3\ 2SiO_2 + 2H_2O$$

corresponding to 46 per cent. of silica, 40 per cent. of alumina, and 13 per cent. of water. This may be regarded as the true clay substance, and is the most refractory combination of silica and alumina that exists. Such a complete result is rarely attained, however; and the intermediate fire-clay is more often the product as at present known. Fire-clays may be represented by the general formula:

$$Al_2O_3\ 6SiO_2$$

corresponding to 60 per cent. of silica and 20 per cent. of alumina, together with a varying amount of water, and small, but important, remnants of their original mother rocks or extraneous deposits in the shape of lime, potash, soda, and iron, all of which are impurities, and exercise a most deleterious effect on the refractoriness of the clay if present in excess. The cause of this is that the silicates of these bases are far more fusible than that of alumina; and often their presence results in the formation of multiple silicates, which are still more fusible when subjected to even moderately high temperatures. But the whole question of the relation which the refractoriness of clays bears to the chemical constituents is a most intricate one; and it cannot be said that any very determined efforts have been made in this country towards their solution.

The general practice has been to consider the refractoriness to be in direct ratio to the percentage of silica present, as found by ultimate analyses, and the absence of impurities, iron, lime, alkalis, potash, soda, &c., which are usually limited in the aggregate to about 3 or 4 per cent. Such an assumption is, however, an accurate one only within certain limits.

So far as the author is aware, the German chemists Richter and Bischof were the first to attempt to establish a relation between the composition of fire-clays and their refractoriness; and in the latter's treatise on the subject, he enunciates a law for expressing the refractory character of clays by a numerical coefficient based on the relation of the silica and alumina to each other, and to the other fluxing bases, as found by analysis. This law, however, proved quite unsatisfactory when applied to other clays than those tested by Bischof; and after much investigation, Seger substituted a modified formula, to read:

$$\text{Refractory quotient} = (A + B)\frac{A}{B},$$

where A represents the ratio of alumina and B that of silica to the fluxes taken as unity. But the author has found this formula of little use in arriving at definite conclusions as to the refractoriness of any clay, as compared with another from a different mine; and Seger himself eventually restricted its use to relative comparisons and for determining the refractoriness of various silicates of alumina.

All the evidence collected tends to show that great difficulties are encountered in attempting to establish a relation between the composition and fusibility of clays from investigations based on the ultimate analysis. It is possible, however, to arrive at more definite conclusions. But in order to do this, some other methods of examination must be pursued than those usually employed which proceed to investigate fire-clays by complete analyses. As an instance of the futility of the latter method, the following is an example of an analysis of a Stourbridge clay of medium quality:

Silica	64·62 per cent.
Alumina	21·65 ,,
Ferric oxide	1·48 ,,
Lime	1·88 ,,
Magnesia	0·62 ,,
Moisture	9·62 ,,

This clay does not make satisfactory firebricks. But why this is so is not revealed by the analysis. The latter gives no information as to the condition in which the silica is present in the clay. It may exist as quartz, or in combination with alumina; and these different states have a great effect on the refractoriness. A complete analysis, of course, shows the amounts of iron, alkalis, lime, &c., and so to some extent indicates its properties; but these depend also very considerably on the combination of the elements, and on the physical form of the mineralogical constituents. Such an analysis assumes clay to be a homogeneous chemical compound, which it most certainly is not; and from what has been said of their formation, it will be understood, without further pursuing the matter, that they are, instead, mechanical mixtures of the various processes of weathering.

Fire-clays really consist of mixtures of

(1) True clay substance (the result of complete weathering) approximating to the formula.

$$Al_2O_3\ 2SiO_2$$

(2) Quartz (as sand of various sized grain) SiO_2.

(3) Felspathic remnants of the original rocks. $RO\ Al_2O_3\ 6SiO_2$.

It does seem striking, on reflection, to throw all these very dissimilar substances into the same pot after dissolving them up, and to proceed to an investigation which takes no regard whatever of their differences. By separating the clay into its mineralogical constituents, on the above-mentioned lines, a far more accurate estimate can be made as to its value. A better knowledge will be obtained of the inner constitution of the clays, and of the distribution of its constituents—which of them do not weather at all, such as quartz, which belong to constituents capable of weathering, as the mineral felspar fragments, and which to the real clay substance in the widest sense. Such a separation can be effected by the decomposition and solution of the clay substance (kaolin) by hot sulphuric acid and sodium hydrate. Alumina is determined in the remainder so as to estimate felspar; while the quartz is determined by difference.

The following analyses of three clays show that they may be similar in composition when analyzed by the one method, but entirely different by the other, or both may give similar results:—

—	"A."	"B."	"C."
	Per Cent.	Per Cent.	Per Cent.
SiO_2	60·49	62·52	56·14
Al_2O_3	26·10	25·57	30·99
FeO	2·11	0·92	0·80
CaO	trace	0·65	nil
MgO	0·56	0·10	0·27
Alkalis	1·08	1·04	0·78
Loss on ignition	9·20	9·27	11·27
Clay substance	71·54	72·05	79·47
Quartz	25·97	27·78	18·92
Felspar	2·49	0·10	1·61

The clay substance is highly refractory, and its presence usually indicates a refractory clay. The effect of quartz is variable; but in the absence of felspar, and when the grains are not very small, it tends to increase refractoriness. If much felspar is present, the fusion point is lowered, as will be understood from its alkali constituents.

To complete the investigation of the clay on these "rational" lines, a mechanical analysis is also most helpful. This can be effected by a special washing apparatus, such as that devised by Shoene. After boiling, a given weight of clay is placed in this apparatus, and a stream of water of definite speed is allowed to pass through and wash out the finer particles. By working at various speeds, particles of various sizes and characteristics are obtained separate from each other. In this manner the clay may be divided up into clay substance, silt, dust sand, fine sand, and loam sand; and if, then, different portions are analyzed, further clues are obtained as to the best methods of handling the clay before use. Thus it has been found by experiment that quartz sand acts as a flux when it is in an exceedingly fine state—so fine, in fact, that it cannot be separated from the clay substance by washing. Coarser particles increase the refractoriness. Other facts of the utmost importance, if a true estimation of the value of a fire-clay is to be arrived at, are revealed by such an investigation, for, having divided up the substance in this manner, investigation by ultimate analysis is now permissible.

Of the relative merits, as refractory agents, of the clay substance (or kaolin) and quartz, separated as above, it has been found as the result of extensive experiments by Bischof, Seger, and others that alumina is slightly more refractory than silica, and that, mixing silica and alumina in various proportions, the composition $Al_2O_3\ 2SiO_2$—*i.e.*, kaolin or

true clay substance—is the most infusible. The addition of silica increases the fusibility until the composition $1Al_2O_3 : 17\ SiO_2$ in chemical equivalents is reached; and with further increase of silica, the refractoriness rises. This is represented graphically in the subjoined diagram (fig. 5).

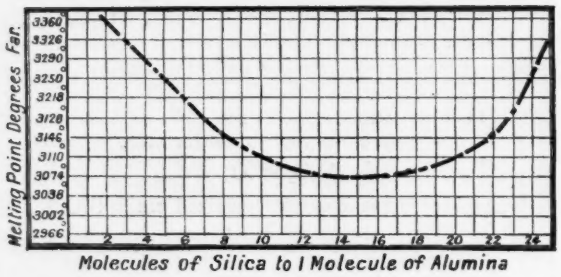


Fig. 5.

The curve illustrates the effect of the addition of silica on fusibility, and also that when there is no alumina present the refractoriness rises to 3326° Fahr.—the melting point of pure silica. It should be noticed that the melting point of pure silica is slightly less than that of the pure clay substance. The position of a clay in the refractory scale depends, however, not merely on the ratio of alumina to silica, but mainly on the amount of accompanying fluxes, iron oxides, lime, magnesia, potash, and soda. Extensive experiments carried out by Bischof and Richters seem to show that these substances act as fluxes in the ratio of their equivalent combining weights—*i.e.*, 20 parts of magnesia will have the same effect as 28 parts of lime, 36 parts of ferrous oxide, &c.—and that they exert the greatest fluxing action on the clay when it is high in silica than when it is high in alumina.

Reverting, again, to the more rational methods of investigating fire-clays, it is a matter for regret that fire-brick manufacturers do not avail themselves more of the great value of such analyses. The author has visited many works in this country, but has never yet found anywhere such investigations being carried out; the methods employed in many places being very primitive.

If, from time to time, new clays are met with, pieces are taken from the top, middle, and bottom of the seam, and burnt on the curtain wall of a kiln. If this reveals certain satisfactory evidences, other pieces may be placed in a cutting heat on the bridge of a reverberatory furnace; and if this test still proves satisfactory, the clay may be subjected to weathering, and eventually made up into bricks, and very often the buyer unwittingly completes the manufacturer's knowledge of the new material by his complaints or satisfaction as the case may be!

In some cases clay samples and bricks are submitted to analytical chemists from time to time; but the number of works possessing a scientific staff is exceedingly few. This is very surprising, considering the intricacies of the raw material and the vast interests concerned.

To sum up, then, it may safely be stated that the ultimate analyses of a clay, as usually employed, are of very little use in arriving at a proper estimate of refractoriness, and that far better knowledge is that based on mechanical and rational methods for subdividing it into its various mineralogical constituents, when ultimate analyses may be employed. Having arrived at a true knowledge of the constituents of the clay on these lines, samples and mixtures may be tested with success in a practical way in a small furnace such as those to be described later.

Composition of Fire-Bricks.

Having dealt with the question of the constitution of fire-clays, and the effect this has on their fusibility, the finished product may now be discussed. As a general statement, it is, of course, true that, unless the clays are good, the resulting brick material cannot well be expected to be so. But this requires certain qualification. Many clays when mined have a fairly high content of impurities—*i.e.*, alkalis (potash, soda, &c.), lime, and iron—and if bricks be made from the raw clay, the result is disastrous. It is therefore again exposed to the action of the weather; and the process of the complete reduction of the rock to clay which was interrupted many thousands of years ago is resumed. The chief agents are, again, water and frost. The water sinks into the pores of the clay, reaching the minimum of volume at 4° C., and expands very suddenly on going over to the solid state. The beneficent effect which the freezing process exerts in loosening and disintegrating the clay mass has always been recognized by fire-brick manufacturers; and most clays are considerably improved by weathering. If one desires an effective result of the weathering and freezing process, it is very essential to make the layers of clay no deeper than the frost is wont to penetrate into the ground—certainly not more than 2 feet—and to pile it as loosely as possible. If this is done, in addition to improvement in the texture and body of the clays, considerable removal of impurities is effected, as seen from the following analyses of samples of the same clay before and after weathering:—

Before Weathering.		After Weathering.	
Silica	64·62	Silica	64·70
Alumina	21·65	Alumina	22·90
Ferric oxide	1·48	Ferric oxide	1·30
Lime	1·98	Lime	1·01
Alkalis	1·62	Alkalis	·75
Moisture	8·52	Moisture	9·52

The clays which are usually most improved by weathering are the strong clays containing a high percentage of silica and impurities—a class in which, as previously explained, the original weathering process was not carried far enough to break down the crystal form. One notable exception to this general acceptance of improvement by weathering is the well-known Glenboig clay, which appears to be very little improved by weathering. But this is undoubtedly attributable to the high percentage of alumina present, and the small amount of impurities.

After weathering, the clay is taken to the grinding mill, where the requisite mixtures of raw clay are made. Few fire-clays can be used by themselves as mined, even after weathering; the general rule being to make up mixtures of the various clays available—strong, mild, or medium—according to the goods required. A certain percentage of calcined clay, or grog, is also added in varying proportions, for the purpose of reducing shrinkage and opening up the texture of the clay. For retorts and large blocks and tiles, 30 to 40 per cent. is usual, and for 3-inch bricks 15 to 20 per cent.; but these proportions will vary somewhat with the clay used. If too much calcined material be employed, the result will be a brick of loose, coarse, friable nature, lacking strength. The relative sizes of the constituent parts and the mechanical condition of the clay as it leaves the grinding mill have considerable influence on the refractory character of the manufactured brick. The larger the grain the less likely is it to fuse when heated, as the ultimate fusion naturally commences from the outside of the grain of the mineral constituents. Where the grain is small, more intimate and extensive surface-contact is possible, and so complete failure by fusion more often occurs in fine-grained than in coarse-grained material. This is well indicated by the three pieces of retort material shown, all of which are made from the same clay, which is of good quality but of different degrees of fineness—viz.: (1) Coarse (2) moderately coarse, and (3) fine grained.

The samples have been subjected to a temperature of 2600° Fahr.; and whereas the coarse grained specimen shows very little sign, and the moderately coarse only faint signs of fusion, the fine closely-grained piece shows considerable fusion. Mild dense clays of moderate fusibility sometimes receive, after weathering, an admixture of silica quartz as sand or crushed rock, with the intention of raising their fusing point; but such an experiment is rarely completely successful.

The finished brick material, after being carefully dried and burnt, should present a cream or buff coloured fracture and external appearance; but the latter is frequently altered by the process known as "flashing," on completion of burning. Bricks burnt in an oxidizing flame are white, and in a reducing flame brown; but the latter coloration may also be due to iron.

The chemical changes consequent on burning are: (1) Elimination of all carbonaceous matter; (2) dehydration of the silicates of alumina, destroying their plasticity; and (3) reduction of carbonate or protoxide of iron, converting it into anhydrous sesquioxide, to which the yellow colour of the brick is due. If burning be carried to a high temperature, the yellow colour is replaced by a dull, greyish brown or red, due to the partial reduction of the sesquioxide of iron and its conversion into silicate of the protoxide or minutely disseminated particles of metallic iron. Lightly-burnt bricks containing small nodules of iron oxide sometimes reveal the

THE "NO FAULT" COOKER

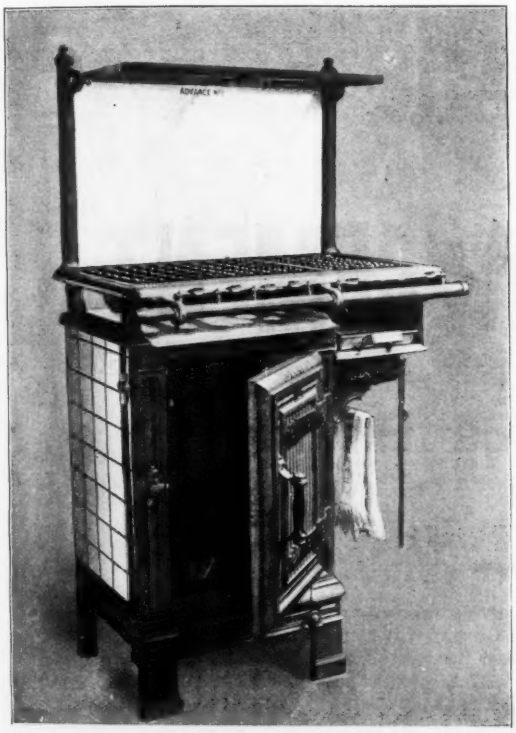
PERFECT RESULTS with the PERFECT APPLIANCE.

THAT IS—

THE NEW "ADVANCE" GAS COOKER

in which have been evolved

16 DISTINCT AND NOVEL DEVICES.



The result of our

FIFTY-FOUR YEARS' EXPERIENCE

combined with

Valuable Practical Suggestions

From MISS HELEN EDDEN

(Principal Demonstrator to the Gaslight and Coke Company).

THE "ADVANCE"

Is the Last Word of Modern Science in Gas-Cooker Construction.

THE "ADVANCE"

Is a Cooker whose Details make

"THE PERFECT WHOLE."

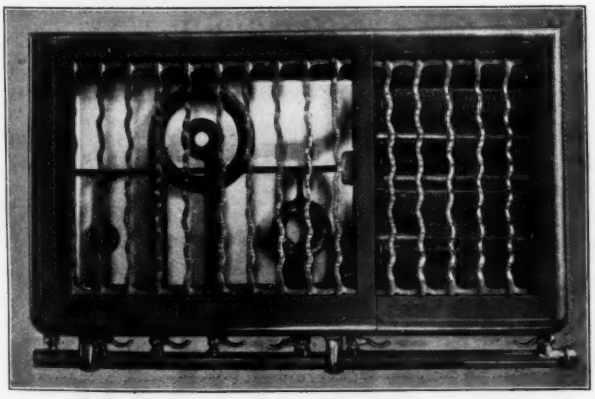
THE "ADVANCE"

Has Unique Contrivances for

TIME-SAVING,
LABOUR-LIGHTENING,
COMFORT-BRINGING,
GAS-ECONOMISING, Etc.,

making it

A COOKER WITH SUPERLATIVE QUALITIES.



HOT PLATE.

Write now for Full Particulars to

WILSONS & MATHIESONS, LIMITED,

Carlton Works, Armley, LEEDS.

London Show-Rooms: 76, Queen Street, CHEAPSIDE, E.C.

HIGH-GRADE
SILICA BRICKS

PLASTIC SILICA CEMENT

For Setting Silica Bricks.

The Best and Most Durable Materials in the Market for Gas-Works Furnaces.

STEPHENS & CO.,

KIDWELLY.

latter by a pink coloration, which gradually darkens to a greenish black as the temperature of burning increases.

Iron is not nearly so dangerous an impurity when the clay is rich in alumina; the highly refractory clay bauxite, which contains 60 per cent. of alumina and 20 per cent. of iron, and only a small percentage of silica, is infusible at very high temperatures. Where intense heat is not to be encountered, and refractoriness with toughness and strength is required, bricks rich in alumina and containing 3 per cent. of iron will give good results. Other fluxes, however, must be absent. Such bricks (*i.e.*, those rich in alumina) exhibit considerable shrinkage when first burnt; but if burnt in the kiln at a high temperature, they do not show subsequent shrinkage or variations. Iron oxide should only be allowed in very small quantities in bricks subjected to producer gas and such like, by which it is reduced. If carbonaceous matter be present to the extent of 1 per cent., the sesquioxide causing the colouring is reduced to the lower oxide, which is preserved as a colourless silicate. If lime and other alkaline earths be present also, the colouring effects of iron are checked by the formation, at only moderately high temperatures, of double silicates of lime and iron. If a fairly large percentage of free silica be present, with 2 per cent. or more alkalis, a dark vitreous combination is formed if burnt at high temperature; but it is possible for alkalis to be present in a fire-brick without revealing themselves by colouring effect, and no brick should be accepted for use where high temperatures are to be withstood containing more than a total of 1 per cent. of potash and soda. If temperatures are moderate, 2 per cent. may be allowed, provided other fluxes are low.

From what has been said, it will be understood that it is quite impossible to form a correct judgment of the refractoriness of a fire-brick by its colour, though, after considerable experience of the clay goods of any district, it is possible for a practical man to give an approximate opinion of the value of a brick from the appearance of its fracture, providing it is well burnt. This latter should always be insisted on. Hard, clear-ringing, heavy, well-burnt bricks usually prove most refractory and serviceable, other things being equal; and impurities can at all times be more easily detected in a well-burnt brick than in a lightly burnt one. Bricks, during the process of burning, should always be subjected to as high a temperature as they will be required to withstand in work. Unless this is done, subsequent shrinkage may occur.

Highly Silicious Fire-Clays.

Differing somewhat from the ordinary fire-clays are several highly silicious clays of considerable refractoriness. These usually contain from 85 to 90 per cent. of silica, and a small percentage of alumina and impurities. Such are: (1) The ganister fire-clay of South Yorkshire: (2) the fire-clay deposits in the limestone hills of Derbyshire and North Staffordshire, &c., and other "deposit clays" in various parts. The first named has most probably been formed by the disintegration of sandstone; and the alumina content may have been incorporated from neighbouring clay-forming rocks, or from the same rocks. Such material usually contains:—

Silica	88·76 per cent.
Alumina	7·56 ,,
Oxide of iron	1·55 ,,
Lime	0·80 ,,
Magnesia	1·24 ,,

(Analysis of a piece of ganister calcined clay.)

It is used as mined, without weathering, but with addition of 25 to 30 per cent. of calcined material. Bricks made of this clay show no sign of fusing at a temperature of 2400° Fahr., and are therefore suitable for places in retort-settings where the temperature is not intense. Being of a loose and fine nature, without plasticity, it is unsuitable for making large blocks and tiles; but ordinary 3-inch bricks are hard and fairly tough.

There are numerous pockets of the second-named clay, occurring in irregular hollows in the mountain limestone of Derbyshire and North Staffordshire; and they are also said to be met with in North Wales and Ireland. The deposit consists of fine white clay and clean sharp sand, sharply separated, together with insoluble remnants from the local dissolution of limestone, intermingled with the *débris* of the overlying millstone grit. Fig. 6 may be taken as a fairly typical cross section of one of these pockets. Many of them are of considerable width, and of depths running down to the water; and the supply would appear inexhaustible. An analysis of the raw clay gives:—

Silica	81·21 per cent.
Alumina	11·47 ,,
Lime	1·27 ,,
Magnesia	A trace.
Iron oxide	1·14 per cent.
Potash and soda	1·58 ,,
Combined water and organic matter	3·66 ,,

The clay is "won" by hand; only a sharp pick being required to loosen it. It is used as found in the raw state, after grinding, and without admixture of calcined material. The bricks, which show no signs of fusion at 2400° Fahr., are of a white, somewhat soft biscuit nature, do not contract or expand on burning, and only very slightly on subsequent heating. The clay is unsuitable for making large blocks and tiles.

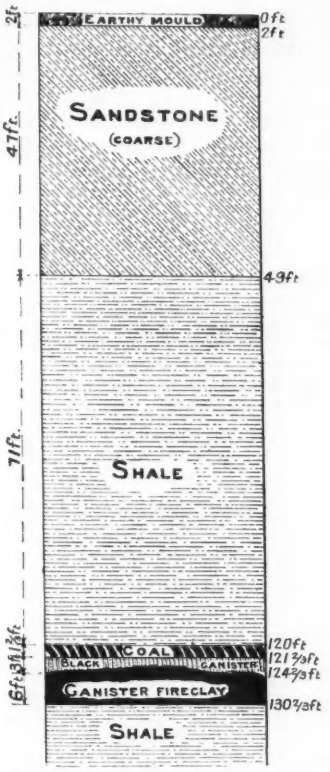


Fig. 6.—Chart of Mine near Sheffield, Showing Black Ganister and Ganister.

Of a somewhat similar class to the above are the deposit clays of Buckinghamshire and Surrey, of which the "Ewell" clay is perhaps the best known, although this latter clay usually contains more silica and iron and less alumina.

Silica Quartz Rock.

The principal sources of this are in the neighbourhood of the Neath Valley in South Wales, and the "black" or quartz ganister found in the neighbourhood of Sheffield. The origin of both is traceable to the disintegration of sandstone; and they have very similar composition. Samples of raw material examined have been found to contain:—

Dinas Quartz.	Black Ganister.
97 6 per cent. of silica.	98·5 per cent. of silica.
0·5 ,, ,, ,, alumina.	0·3 ,, ,, ,, alumina.
1·5 ,, ,, ,, iron.	1·3 ,, ,, ,, iron.
0·2 ,, ,, ,, lime.	0·2 ,, ,, ,, lime.
0·09 ,, ,, ,, potash.	Traces. potash.
0·03 ,, ,, ,, soda.	Traces. soda.

The South Wales or Dinas quartz has a pale greyish blue tinge, and is worked in open quarries (see fig. 7) about 50 to 60 feet high, with thin veins of yellow clay between. The rock is hard; and steam or compressed air drills are used. Very little impurities are found, and the rock is crushed and mixed with 1 to 1½ per cent. of lime and a small percentage of silicious clay to toughen the brick. The lime causes slight fusion of the granules of quartz, and so binds the whole together. No calcined material is used.

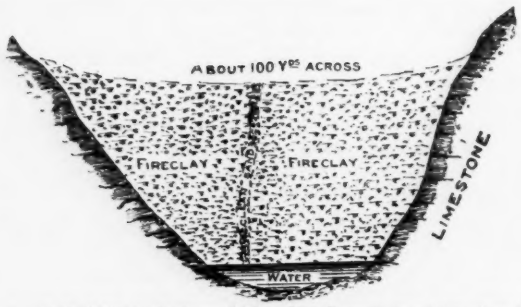


Fig. 7.—Typical Cross-Section of Fire-Clay Deposit in a Limestone Hill.

The bricks are burnt at about 2600° Fahr., and expand somewhat on burning and subsequent heating.

"Black" Ganister.

This forms the seatstone beneath certain seams in the lower coal measures near Sheffield (fig. 8). It is mined by means of rock drills; and the method of manufacture is somewhat similar to that of the Dinas quartz brick, except that there are some fairly well defined impurities found in the raw material, which can be picked out. There is also usually an admixture of 25 per cent. of calcined material or "grog."

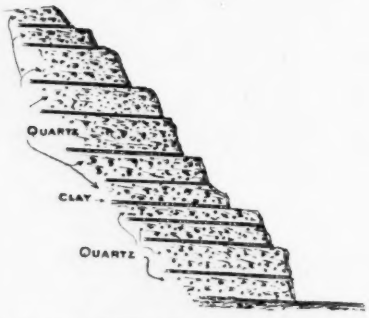


Fig. 8.—Cross Section of a Quarry in Neath Valley.

These highly silicious bricks usually show expansion on heating up, and should not therefore be laid too tightly and with too fine a joint. It is necessary to heat up and let down very slowly, and keep dry before use. They should always be set in their own cementing material.

The Practical Testing of Refractory Material.

It will be gathered from the foregoing that, if examined in a proper manner, much information can be obtained by an intelligent study of chemical analyses. These should be combined with experimental investigation, and fairly accurate results on a working scale may then be looked for. Practical tests, conducted so as to approximate if possible to working conditions, are strongly recommended. Fully reliable information as to the refractory qualities of material can only be obtained by continuous testing at high temperatures under working conditions; and extensive purchase of new material, of which little is known, should not be undertaken unless a few of the bricks have been tried for at least one season in the cross walls of a retort-setting or some such situation. For preliminary, and also comparative, tests, at time of settlement of contracts, some kind of testing furnace is desirable.

A very simple and easily managed coal gas testing furnace very well adapted for such work is used by Dr. Davidson, D.Sc., the Chief Chemist of the Birmingham Gas Department (fig. 9). A supply of coal gas is taken from the inlet of the holders (pressure about 6 to 7 inches); and a blast pressure of 2 lbs. is used. A temperature of 2700° Fahr. is readily obtainable, and on heating the gas and air, by passing the supply pipes through a combustion furnace, a temperature of 3000° Fahr. is possible. The gas burns in the annular space between the silica lining and the concentric silica tube; and the temperature of the furnace may be taken by means of a Féry pyrometer. This exceedingly simple instrument was fully described by Mr. John Bond in his paper on "Pyrometers," read before the Institution in June, 1905. Seger cones may also be used for determining temperatures.

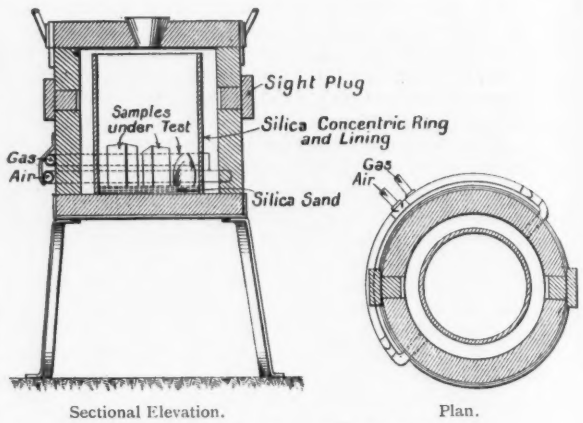


Fig. 9.—A Coal Gas Furnace for Brick-Testing.

As more nearly approaching to the conditions of a working test, however, the author prefers the use of a furnace of a modified Deville pattern (fig. 10). This furnace is easily manipulated; and exceedingly high temperatures can be obtained. The fuel used is a good, hard coke, broken to about 2 inches diameter. When this is not available, retort carbon may be substituted. The casing is of $\frac{3}{16}$-inch wrought iron; and the furnace portion A is lined with magnesite 3 inches thick. B is a wrought-iron plate with four concentric rings of $\frac{1}{2}$ inch diameter holes, with a centre hole of 3 inches in diameter. The chamber C is airtight, and contains a door and $1\frac{1}{4}$-inch diameter connection for air-inlet, which is worked at about 2 inches water pressure. D is a magnesite pedestal, fitted into large centre hole F, and used for carrying sample to be tested. A fire is lighted by means of wood and charcoal in the annular space, and afterwards coke is used; the blast being gradually increased. The air rises through the small $\frac{1}{2}$-inch holes into the combustion chamber above. After the completion of test, the ashes may be removed through the large centre hole F. There are four sight-holes E, for taking temperatures (by means of the Féry pyrometer) and for adding fuel.

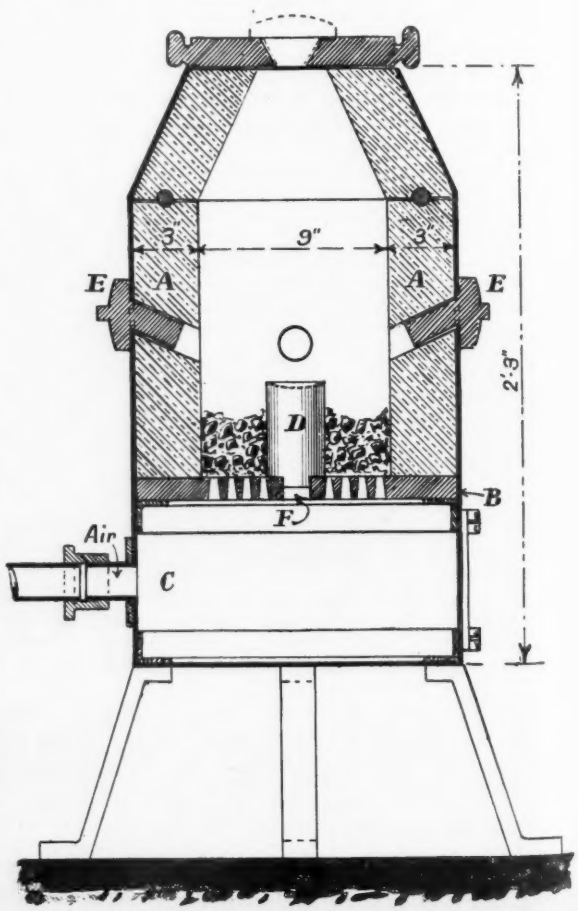


Fig. 10.—Deville's Testing Furnace using Coke Fuel.

THE DESIGN AND SELECTION OF REFRACTORY MATERIAL.

This matter is, of course, a most important one; and many instances might be given of failures in retort settings due to the choice of unsuitable material or design.

All classes of refractory goods should be made of moderate size; large blocks and tiles being eschewed. This particularly applies to quartz silica, and highly silicious clay material, which is unsuitable for large tiles and bricks where tenacity and toughness are desirable. For the lining of producers, good quality fire-bricks are most desirable. Silica bricks are quite unnecessary as regards temperature and also, by reason of the dust and impurities of the furnace gases, unscientific. The texture of the fire-brick material used at these points should not be too open, but rather of heavy specific gravity, somewhat close and tough, with a low percentage of fluxes and free silica. These remarks also apply to the lining of carburetted water-gas generators.

To withstand the high temperature of combustion chambers, the author has found nothing so suitable as silica bricks of the Dinas or black Ganister quartz type. Such bricks stand exceedingly well a combustion chamber temperature of about 2500° Fahr., and show no signs of fusion after considerable wear, unless subjected to a cutting heat, in which case the iron-laden dust from the producer gas may cause fusion. Care should also be taken that the bricks used in the cross walls higher up in the setting are of sufficient refractoriness to withstand the working temperature, as drippings resulting from the fusion, or partial fusion, of these often cause trouble. If silica material is used in arch blocks or bed tiles for retorts, &c., they should be not larger, if possible, than about 18 inches long by 9 inches by 4 inches. In the cross walls of the setting beyond the height of the combustion chamber, high-class fire-clay bricks of Glenboig, Ganister, "Best" Stourbridge, or Yorkshire, and Derbyshire "biscuit" silica, are quite suitable and desirable. Any of these may also be used in combustion chambers where moderate heats are maintained with quite satisfactory results. Recently "artificial" silica bricks —*i.e.*, fire-clay bricks to which an addition of 15 to 20 per cent. quartz, as sand or crushed rock, has been added—have been put upon the market. But these are generally unreliable; and their use is not desirable for high temperatures, at which they show considerable fusion. There is no doubt that in some cases the refractoriness of a dense clay free from fluxing bases is improved by the addition of quartz silica; but these products should be used with great caution.

An average sample of retort-setting flue dust examined contained 48 per cent. of iron; and it will therefore be seen how important it is that all material subjected to its action should be of sufficient refractoriness to withstand the temporary rises in temperature which frequently occur in retort-settings, or the softening which will result therefrom will develop into complete fusion.

For retorts, the material used should be of the best. Owing to the variation of temperature, the grain shou'd be as coarse and open as is compatible with toughness and tenacity. The author prefers segmental retorts to moulded ones, and the majority of the retorts at the Saltley Gas-Works are of this kind.

The average life of moulded retorts of ordinary fireclay material, taken over a large number of years, has been found to be from 700 to 800 days, and that of segmental retorts 1400 to 1600 days with gaseous firing and high heats. For inclined retorts, this latter figure is somewhat less. But for inclined and horizontal retort-settings the use of segmental retorts although heavier in initial cost results in a saving of more than 1d. per ton of coal carbonized during their life, taking account of all charges, labour, and materials. It may be urged that segmental retorts involve loss of gas owing to leakage; but this is not found to be so. Such retorts, moreover, take up expansion and contraction more readily and are more easily repaired.

In the case of moulded retorts, "hand made" are to be preferred to those made by machinery. From the fact that the latter are made in one operation, it might be inferred that greater uniformity of composition is ensured than when the retort is made in "lifts" of about 15 inches at a time. This latter process, however, although having disadvantages, allows of several weeks more tempering and slowly drying, which tend to lengthen the life of the retort. Moreover the heavy pressure requisite for the manufacture of machine-made retorts causes the texture to be too close and compact; and the very nature of the process of manufacture forbids a coarse grained material, which is very desirable. No comparative figures can be presented; but it is certain that machine-made retorts are rarely so satisfactory as hand-made ones.

Complaint is sometimes made that research is urgently required as to the relative conductivity of the various refractory materials for retort construction, and which is the best physical condition in which the material can appear. This may well be; but if, as seems probable, the conductivity varies as the silica content, there is a danger of a tendency to produce friable material lacking strength and altogether unsuitable in other respects. What is really first and most urgently needed is a retort which will give a "life" of 2000 to 2500 days moderate in price and readily obtained.

For segmental retort material, the use of either (1) Best Stourbridge, or Yorkshire Old Mine clay, with a mixture of 10 to 15 per cent. of "Pot" clay, and from 20 to 25 per cent. of burnt material, or (2) Ganister material, or (3) Glenboig, give very good results; and although only costing about 10 to 15 per cent. more than ordinary fireclay material have a much longer life. If these materials are not used throughout, they can with advantage be employed in the crown bricks of the retorts.

Hand-made bricks are usually to be preferred to machine made ones on account of the dense, close structure usually associated with the latter. It is possible, however, by a judicious mixture of calcined material, and by coarse grinding, &c., to ensure a fairly open texture with pressed, machine-made bricks; and considerable quantities of such bricks have been used with satisfactory results. In the case of wire-cut bricks, in order to ensure a good "arris," the texture and grain must be fine, and therefore dense close grain bricks result, which do not answer so well, frequently spliting, cracking, or fusing.

Finally, all classes of fire-clay goods, especially retorts and large blocks, &c., should be allowed plenty of time for making, tempering, and thoroughly drying in the sheds, whereby their life is perceptibly prolonged. Material which has been "rushed" rarely gives entire satisfaction. If large blocks are not dried slowly and thoroughly, a black core results, which will almost certainly cause trouble by shrinkage; and if this be not of great importance, it should be noted that if through the burning away of the outside portions the dark core be ever subjected to action of producer or other gases, it will melt out very easily.

Such cores also occasionally occur in large block, &c., due to insufficient burning and non-destruction of carbonaceous matter.

CONCLUSIONS.

A large number of typical specimens of refractory material have been examined and tested while preparing this paper. It has been thought well not to publish the results of these tests beyond the statements already made; but the most interesting of the samples, with details affixed, are produced for the inspection of members. One sample, however, is of considerable interest—*i.e.*, the piece of retort material which has been in stock ten years and exposed to all weathers. This was carefully dried and slowly raised to a white heat, along with a piece of high-class Belgian retort material of good reputation, with the result that it withstood the test the better of the two. It would therefore appear that the exposure to weather has no serious effect on the refractory properties of fire-brick material, and this is in agreement with the author's experience. Heats should, however, be raised very slowly in such cases. Silica goods should not be exposed to the weather.

It will be seen from the tests that good quality British fire-clay material will withstand moderately high temperatures (2500° Fahr.) very fairly, and that between the best goods from the various chief sources of supply there is not great difference. At higher temperatures, however, they are not so refractory as some of the German samples tested. From a commercial and sentimental point of view this is perhaps regrettable. The highly refractory nature of these is no doubt due to the scientific investigation the German manufacturers have brought to bear on the raw material at their disposal. Their research methods compare remarkably with those employed by our manufacturers, for most of the large works have a highly trained scientific staff.

Time was when considerable quantities of retort material were shipped to the Continent from this country; but very little of this is now done, and the reverse operation has commenced. Compared with the 700 to 800 days which have been mentioned as the average life of moulded retorts

of ordinary English fireclay material working at high heats, some retorts of German make have been known to work in this country much more than double that period. This being the case, it is useless to still pursue the policy of *laisser faire*. The temperature of carbonization seems likely to rise rather than fall, and the advent of the vertical retort has made improvement in retort material imperative unless its supply is to be resigned to foreign makers. There are large deposits of excellent fire-clay suitable for the manufacture of the highest grade retort material still unmined, especially in the Stourbridge, South Yorkshire, and Glenboig districts; and only thorough and scientific investigation and treatment are required to restore British fire-clays to their former pre-eminence. The annual cost of refractory material per ton of coal carbonized in gas-works usually ranges from 4d. per ton in the case of direct fired, to 10d. in gaseous-fired settings. Having regard, therefore, to the huge expenditure involved and the issues at stake in our own industry alone, it would appear that joint action with manufacturers would be most useful. Consideration might well be given to the endowment of a research laboratory at the recently-founded section of Gas Engineering at Leeds University, to which fire-brick manufacturers would doubtless subscribe liberally.

Discussion.

The PRESIDENT said he had taken the opportunity of reading this paper before the meeting, and heartily congratulated the writer on its excellence. It was a splendid paper; and he was only sorry that it had been necessary to curtail it in reading. He was, however, quite sure the members would study it carefully afterwards.

Mr. H. W. WOODALL (Bournemouth) agreed that it was a great misfortune that they had not had the privilege of listening to the whole of the paper. At the same time, he was sure they would appreciate it when they read it, and would benefit by it very largely. As far as his experience went, it was the first paper communicated to the Institution on this subject—a most important one, and one to which sufficient attention had not been given in the past.

Mr. CHARLES CARPENTER (London) said he must express a divergent view with regard to the curtailment of the paper, because he ventured to think it was a distinct advantage that the paper was not read in full by the author. He remembered some time ago his Chairman telling him of his experience on the Labour Commission. He said that what was noticed with regard to the witnesses was not exactly what they said, but how they said it. They had just had a great advantage in listening to the abbreviated description which had been given by the author; and the first thing which impressed him was that that gentleman thoroughly knew what he was talking about. He did not think they would have got such an emphatic impression from a mere reading of the paper. The author's grasp of the subject was now apparent to all; and those who had had the pleasure of listening to him would give more attention to the paper than they would otherwise have done. He wished emphatically to corroborate the author in what he had said with regard to the German manufacturer. He was to-day the best manufacturer of fire-clay goods. If one wanted the best, one must get them from Germany. Germany had built up this industry, as it had many others, by technical knowledge and education; and unless they in England set their house in order, and conducted their industries in the same way, they would not only not regain the ground they had lost, but would lose still more. He spoke from experience in this respect; and no doubt the author had done so also.

Mr. W. C. JONES (Brierley Hill) said he had read the whole of the paper himself; and it was quite worth the while of every member to do so. The author had taken up the reading at the point which would interest them most—the practical conclusions. He could quite corroborate what he said in the early part with regard to the ultimate analysis of fire-clays. Some few years ago, in conjunction with the chemist of one of the steel works in the neighbourhood, he carried through several experiments, and tried to find out why it was several fire-clay bricks from the Stourbridge district did not stand the intense heat that some foreign made bricks did. With this object, they had a chemical analysis made, and found in many instances there was very little difference in the ultimate analyses of the clay; the conclusion they came to being that the difference was due to the physical condition of the clays. He quite agreed with the author in recommending them to have all fire-clay goods well burnt; for he was convinced that many failures found in settings, of Stourbridge clay in particular, were due to the fact that the bricks had not been well burnt in the kiln. This had been due to a large extent to the indifference of engineers themselves. They specified that the bricks should be perfectly white and square; and in some instances he had known a specification drawn requiring them to be made to a thirty-second of an inch. Those who knew anything at all about fire-clay would know that this was impossible. He thought if more confidence were placed in the fire-clay manufacturers, and if engineers would let them know what they required the bricks for, they would do a great deal better. If they could give them some idea of the temperature to which the bricks were to be subjected, they would prepare a clay which would stand it. The usual thing was to order so many thousand bricks, irrespective of the place where they were going to be used. He felt sure that the Stourbridge fire-clay, if properly made, properly burnt, and properly used, would stand, not the temperature that foreign bricks would, but certainly all that was needed in most parts of retort-settings of the present day. He had had in use at Brierley Hill retorts made in the Stourbridge district which had been in use over 1100 days, working at fairly high temperatures, carbonizing coal at the rate of 3½ cwt. in a 10-foot retort in 4 hours 48 minutes, and producing a fair amount of gas. He could not say they had ever got up to 13,000 cubic feet; but they had over 12,000 feet for the last six years, so it was evident they had had some very good heats behind the clay.

Mr. H. KENDRICK (Stretford) said he must congratulate Mr. Bywater on his excellent paper; but he wanted to contest one of the statements made in it. They had been dealing for the last ten years with two firms in the Stourbridge district whose prices were most certainly first-class, whether the goods were or not. One manufactured exclusively hand-made retorts, and the other almost exclusively machine-made. For the last three years they had put in nothing but the machine-made retorts; and the average life of them proved to be 300 to 400 days more than that of the hand-made retorts. This must be due either to the material or to the method of manufacture, because the whole of the settings were built on exactly the same plan, by the same men, under the same conditions, and with the same supervision. With regard to silica blocks, he agreed with the author. He started with large blocks, and came down to small ones. With regard to bricks for generators for carburetted water-gas plant, he found it necessary the first year or two to renew most of the blocks in the generator every season. Then he approached one of the manufacturers, and told him exactly what they required the blocks for; and they gave them a number of blocks, and finally extended the same material to the checker-work for the superheater, which had resulted in their not having to renew any of them (except those immediately round the air-inlets) for the last three seasons. They had paid a few shillings more per thousand for the blocks; but it was money well spent. What really brought him to his feet was the paragraph referring to the Engineering Section at Leeds University, and it was the remarks made by Sir George Livesey the previous day which he wished to comment on. Sir George said that the gas companies, at all events of the North, and a great portion of the district, had not contributed largely to the £500 required for the Leeds University professorship. But he (the speaker) would like to point out that these gas companies certainly had contributed to the Special Purposes Fund of the Institution, which, in its turn, sent £100 a year to the Leeds University. If the Institution Council could persuade the engineers of corporations to contribute in the same manner in which gas companies contributed, they would not only be able to spend more money themselves on direct research, but could possibly make up even the whole £500 wanted for the Leeds University. He had taken the trouble to go through the list which appeared in the report, and found that, out of over a hundred contributors, only nineteen came from corporations. He hoped this fact would be taken to heart by those who represented corporations, and that they would persuade their committees to be a little more generous.

Mr. J. W. MORRISON (Sheffield) said Mr. Bywater had placed before them a fresh aspect of the fire-clay industry. He should like to say how pleased he was to find the author preferred the brick retort to the moulded one. It was now some thirty years since they first put them in at the Saltley Gas-Works, and they had gone on increasing year by year.

Mr. Bywater also said the life of them should be from 1400 to 1600 days. He (the speaker) had taken out brick retorts at Sheffield which had been working nearly 3000 actual working days; and the average would be certainly 2500 days. As regarded leakage from brick retorts, he had run benches comparable with moulded retorts, and had found absolutely no difference in them. They were much easier to repair; and certainly their life was much longer. As regarded the construction of segmental retorts, in Sheffield they preferred the bottom tiles and side tiles which came in contact with the rake to be made of something like Stourbridge material, because it stood the wear and tear better; but for the arch portion they had a material containing 85 per cent. of silica, because this kept its shape better and was much more easily repaired.

Dr. H. G. Colman (London) said the paper had had exceptional interest for him, not only on account of its intrinsic importance—dealing with a subject which had been too much neglected in the past—but also more or less on personal grounds, because this subject had been much discussed between Mr. Bywater and himself in years gone by, when they were working together. It was brought about by the failure of fire-brick material; and he had still a very vivid recollection of their crawling together through settings which were just cool enough to get into, and finding the so-called fire-resisting material softened, having brought about collapses, and having even run completely, and remained hanging in stalactites, which would have been very beautiful in a limestone cavern, but were anything but a pleasurable sight in a retort-setting. Mr. Bywater had given an immense amount of attention to this subject during the last ten years, both from the fire-clay manufacturer's point of view and from that of a general investigation of the subject; and the result was given in comparatively short compass in the paper, which they would all do well to study in detail. It put together the gist of the matter far better than anything else he had seen. He was very glad that the author had called special attention to the absolute futility of the ordinary analysis of fire-clay material, which merely gave the ultimate analysis without any reference to the manner in which the constituents were combined, and the mechanical and physical properties of the substance. It was only by such complete analysis, including a microscopic investigation, that really valuable information could be obtained. Such analyses were quite impossible to be undertaken in ordinary gas-works. It was really a matter for the fire-clay manufacturers; and they must all regret that so little work was done in this country in that direction, though he believed things were rather better of late. But there was no reason why much good work should not be done by systematic testing of material; and any time spent on this matter would be amply repaid in the length of life of the settings, and in lessening the cost of repairs.

Mr. Thomas Glover (Norwich) said he also wished to state how valuable he considered the paper as a permanent contribution to their knowledge of this important subject; and he, like other engineers, had had varied, and sometimes very disappointing, experience with refractory material. As an Englishman, however, he did not wish it to continue to be said that the Germans could make of the self-same natural material better fire-resisting goods than they could in England. He hoped one result of the paper would be the removal of this reproach. It might assist to hasten the removal if they could see their way to help to bring about the joint action with the manufacturers which the author recommended. Now that there was an Association which represented the firms who supplied them with goods, he thought it would be an easy matter to arrange for such a conference. The three things they wanted to avoid were, fusion, expansion, and contraction. It appeared that even goods with a reputation changed character from time to time, and that they needed to be very careful before committing themselves to large purchases, if they wished to prevent disappointment. It was possible to buy in this country fire-resisting goods which would stand any temperature they were likely to reach, and to so construct the combustion chambers and the walls of the settings that they would properly keep the setting in shape and last for from 2000 to 3000 days. It also seemed clear to him that the weakest point of the setting, now that they had found the right material for the combustion chamber, was the retort itself; and that they would improve the settings and increase their life by building them in sections, as Mr. Morrison and others had recommended. They could then choose the material very much better than if they had moulded retorts. They would thus put themselves in a position to stand the very much higher temperatures that were now in practice.

Mr. Douglas Helps (Reading) said he would like to confirm the author as to the greater life of the segmental as compared with moulded retorts. He thought the reason was that they were much more easily repaired. He should like to ask Mr. Morrison with regard to his retort which lasted from 3000 to 4000 days, if he could say how much of the original retort remained when he came to pull out the setting. He thought the life was more apparent than real.

Mr. Morrison said he should think there was quite 75 per cent. of the original retort. The wear and tear really took place at the bottom. The top arch of the retort and the interior of the setting was in much the same state as when originally put in.

Mr. A. Wilson (Glasgow) said he thought much of the variation in fire-clay goods was due to the different methods in which various manufacturers treated the clay. They got most of their fire-clay goods from the Glenboig district, and, the manufacturers themselves said, from the same seam. But, if so, why did the clay give very different results in bricks and retorts? He was very much puzzled over this; and, after a good deal of investigating—they not only tested the fire-bricks themselves, but actually visited several of the clay-works, which perhaps was the best way of getting rid of the trouble—the only reason he could find for the excellence of one firm's goods was that they had a very large stock of fire-clay always on hand. They kept adding to this stock at one end, and taking from it at the other; and consequently the clay which was used was very well weathered. At another works from which there was a considerable output, they used the clay practically as it was mined. The best goods turned out from the first-named place were those which had the largest percentage of weathered material added to that which was newly mined. He believed that was the secret of their success; and it practically bore out what Mr. Bywater had told them.

Mr. Vincent Hughes (Smethwick) remarked that, as some doubt had been raised by previous speakers as to the life of a retort, and the question was asked how much of the original retort was preserved, he could only say that he was rather surprised to find that at Birmingham they got only 700 to 800 days' life out of a retort. He had at present both slopers and horizontals, which had been working between 1300 and 1400 days, and were working well; and Mr. Bywater would confirm him when he said that they did work them at Smethwick. They were ordinary fire-clay retorts; and as Mr. Bywater nearly doubled the life of segmental retorts, worked in the same manner as they worked them the retorts ought to last from 2000 to 3000 days, as a previous speaker had said. The author condemned machine-made retorts; but personally he (the speaker) preferred them to hand-made ones, and he had both at work at the present time. He had not found a very great deal of difference; but he gave preference to machine-made retorts as being straighter and better shaped generally. As to German retorts, Mr. Bywater said that at a certain date there was a heavy fall in the delivery of goods to the Continent; but this occurred at a time when the duty on retorts was greatly increased. He did not differ from what Mr. Bywater said as to the superiority of foreign-made retorts; but the duty had a great deal to do with the quantity of material delivered both to the Continent and to America.

Mr. Bywater, in reply, thanked the members for the manner in which they had received the paper, especially Mr. Carpenter for his kind remarks, as that gentleman had always been one of his heroes since he first started in the gas industry. What had been said more than repaid him for the trouble he had had in preparing the paper. As Dr. Colman had told them, his (the speaker's) interest in this subject was born in disaster, and serious disaster, too, due to the failure of retort material which they had always hitherto considered irreproachable. Material which had stood them in good stead in previous years failed from some unaccountable reason. When, however, they came to investigate the matter, they found very good reasons for it—such reasons as had not been taken into account by the manufacturers, and, he believed, were not taken into account now. This was more especially serious in the Stourbridge district, where many manufacturers who had very high reputations for excellent material in past years had worked out their old mine clay, and were getting now into their new mine clay. This was far inferior to the old mine, which was

almost theoretically perfect, and with which they made good fire-clay retorts and bricks without knowing why they did it. Now they had something they did not quite understand; and they were getting into difficulties. His own personal experience of the Stourbridge district was that there was excellent material there; but it was not properly handled. With regard to the desirability of segmental retorts, he feared that some speakers thought he commended them. He did not commend them, except that they gave a longer life. They were more costly to put in; but they were more easily repaired. If they could get a moulded retort which would stand 2000 or 2500 days, it would be just as good as a segmental retort. The reason they had them was that they lasted longer, and, as made at the present time, were more capable of contraction and expansion, being in small units. He felt sure, however, that if they ever got theoretically perfect material, such as was manufactured in Germany, they would cease using segmental retorts in such large quantities, and go back to moulded retorts. With regard to the advantages of weathering the clay, he quite agreed with Mr. Wilson, who said the manufacturers who weathered their clay, generally speaking, produced better results than those who did not. The instances given in the paper of the advantage of weathering were not so striking, because the clay was a fairly good one; but he had analyses of clays containing 3 and 4 per cent. of lime in the clay, which made excellent bricks. He had it on the authority of several very eminent manufacturers that 3 or 4 per cent. of lime was very easily got rid of, and 1 or 2 per cent. of alkalies, by means of weathering. Mr. Hughes did not agree with regard to the life of retorts; but he could say that the statement was not made loosely. He had not any experience of machine-made retorts, and did not think there had been any at Saltley; but the statement was made after careful inquiries, and he was assured by engineers who used them that they did not last as long, in the main, as hand-made retorts. The reasons he had given were, he thought, quite substantial—that the material could not be tempered and slowly made and dried. It could be so made; but they did not get the opportunity. The fact that the retorts were made at one blow was taken advantage of. They were dried right off, and sent to the kilns. If they took more time over the material, there was no reason why, if the clay was roughly ground and tempered properly, it should not be as suitable as the other. He did not like the process, because one must not put too much pressure on fire-clay material. If this was done, the material was too dense, and it did not last so well. He was quite prepared to accept the statement that some gentlemen had made that they lasted well; and he could only attribute it to the fact that they had had tempering, and that the manufacturers who made them recognized the weakness of the process, and took steps to remedy it. Generally speaking, the evidence he had gathered the last five or six years tended to show that machine-made bricks and retorts were not so reliable as hand-made ones.

Rust-Proofing Iron, Steel, &c.—Mr. A. Bontempi, of New York, has taken out a patent for an improvement in a process previously patented by him for rendering iron, steel, &c., rust-proof. According to an abstract of the specification which has been published in the "Journal of the Society of Chemical Industry," iron or steel articles are rust-proofed by heating in a closed chamber for two to six hours at a temperature of 1000° to 1800° Fahr., in the vapour of non-corrodible substances—*e.g.*, a mixture of tannic acid, an oleaginous material, and a non-corrodible metal such as zinc, or its oxide, a pure metal such as zinc or lead, or hydrocarbons such as coal tar or pitch. The articles may be first subjected to the Bower-Barff treatment (treatment with steam at high temperatures), in which case a tray of lime may be placed within the chamber to dry the steam. A small quantity of naphtha may be injected with the steam to give a black colour to the coating.

The Law as to Patents, Designs, and Trade Marks.—We have received from Messrs. Cruikshank and Fairweather, Limited, a little work on the above subject which they have just published. Its object is primarily to provide an adequate reply to inquiries which are addressed daily to a patent agent by inventors and others. It is intended, as the authors state in the preface, as "a business man's guide to the law of industrial property;" and it deals with questions of industrial or political history only where historical considerations are of practical importance in the interpretation of the law as it now stands. The first part of the book is divided into three main sections, corresponding to the three subjects of legislation—*i.e.*, patents for inventions, designs, and trade marks; while the second part is devoted to the subject of foreign and colonial laws on these matters. The book is issued from the offices of the authors, 65 & 66, Chancery Lane, W.C., and 62, St. Vincent Street, Glasgow.

FRANCO-BRITISH EXHIBITION.

The Gas Section.

When the members of the Institution of Gas Engineers paid their official visit last Thursday to the Franco-British Exhibition, and inspected the Gas Section, they found everything save one bay on the industrial side completed. There is nothing to be added to what has been said before, or is said in another part of this issue, under "Social Events and Visits" (p. 787), about the Gas Section Committee's exhibit; but, facing the suite of rooms, there have now been completed two or three stands fitted up by well-known manufacturing firms that have not been previously or sufficiently noticed in our references on May 19 and since.

Messrs. W. J. Jenkins and Co., Limited.

For the heaviest single pieces of gas-works plant that have been brought into the Gas Section, Messrs. W. J. Jenkins and Co., Limited, are responsible; but though time has been short since the firm resolved to exhibit, they got their plant into position and in working order by Thursday afternoon. The "D.B." projector, fitted in travelling frame and everything complete, was seen charging beans into a 10-feet length of wooden retort properly fitted with a mouthpiece. Another machine of the free suspended type, and a 20-ton coal-breaker are among the exhibits. Excellent work is found in the firm's productions, about all of which more will be found in our issue for May 19.

Messrs. Clapham Bros., Limited.

When one thinks of Clapham Bros., the trade name of "Eclipse" always comes to mind. Almost everything on the stand appears to be so named. Centrally staged we have one of ten cylinders used in Clapham's "Eclipse" washer-scrubber. These cylinders are made up to 10 feet diameter; but the one on view is hardly half that, and is known as the No. 4 size. These cylinders are filled with small wooden balls, drilled through; and they give a large amount of wetted surface for the extraction of ammonia. In the revolution of the cylinders, the balls scrap together and so, with that reciprocity which shows a kindly spirit, they keep one another clean. In conjunction with this section, a new driving gear and engine for the firm's washer-scrubbers are shown. It is on an altogether new principle; the worm running in an oil-bath. A patent tar-extractor claims notice. It works by pressure, and has ball-bearings. The rectangular boxes in which are perforated plates are so constructed that the gas comes into intimate contact with the plates. It is one of those constructions, however, that can better be appreciated by inspection than by verbal explanation. Another exhibit is the system of fixing rubber jointing to luteless purifiers. In place of cement, a steel clip is used for the rubber; and, as pressure is brought to bear on the rubber, it is free to move as it wishes in the clip. The rubber cannot come out; and there is no fear of breaking joint. It is interesting to note that no less than 25,792 feet of jointing on this new system has already been supplied. In conjunction with this exhibit is a section showing the mode of applying Clapham's rapid automatic fasteners to the covers and boxes of dry-lute purifiers. With the system shown, any number of fasteners round a lid can be actuated by one motion of a shaft. Labour is saved, the same pressure is secured all round, and simplicity takes the place of the old cumbrous methods. A regulating-valve for hydraulic mains, a small Livesey washer much strengthened and improved, a 24-inch rack and worm valve, a 24-inch rack and pinion valve, and a mouthpiece on an improved principle are among the other goods on view. There is also an example of casting in the rough; and it is a clean-looking surface that is seen, and a really creditable production. Quite a number of photographs adorn the sides of the stand, illustrating the past work of which the firm are proud. The work is varied, and much of it of great importance. In one picture is noticed a purifier-house and purifiers, in the construction of which 2490 tons of steel were used. There is much of interest to be seen at this stand.

Messrs. Clayton, Son, and Co., Limited.

The next stand is in the occupation of the above firm. They are showing as a central feature a section of Clayton and Pickering's patent improved spiral guide for gasholders. Attention is directed also to the Kramers and Aarts water-gas plant; and numerous photographs record some of the notable engineering achievements of the firm. In their time, there have been many such; and the firm are to be congratulated upon them.

Messrs. S. Cutler and Sons.

This firm are neighbours, and also show an admirably arranged collection of photographs, illustrating a great variety of important gas-works plant which has been manufactured by them, as well as some interesting examples of various constructional works such as grain silos, roofs, viaducts, &c. The lists and photographs exhibited testify to the position the firm occupy in regard to the construction of gasholders and steel tanks of the largest dimensions; and they have the unique advantage of being able to point to one notable example of their construction within the vision of all who visit the Exhibition, as the Kensal Green 8 million cubic feet capacity gasholder erected by them for the Gaslight and Coke Company stands prominently a very short distance

from the Exhibition Grounds. A large number of foreign contracts of considerable extent are also indicated, which seem to show that the railway, river, and dock facilities which the location of the firm's factory provides are important factors in their business economy, especially in regard to export orders. Carburetted water-gas plant is also a noticeable feature in Messrs. Cutler's display; their lists containing the record of over 40 sets already in work, as well as plants now under construction for Cardiff, Aldershot, Amsterdam, &c. Interesting photographs of these various plants are on exhibit. As evidence of the varied nature of the firm's activities, photographs are noticed of large ice-making tanks; and it is understood they have in hand similar plant for one of the largest ice-making installations now under construction in this country. A firm engaging in such work as is here referred to obviously cannot exhibit in kind; but the photographs, &c., which they have brought together are sufficiently conclusive evidence that this old-established firm are fully maintaining the prominent position they have so long held in the gas engineering world.

APPLEBY'S LIMITED.

With Appleby's Limited have been incorporated the Temperley Transporter Company; and among the manufacturing firms at the exhibition they are showing examples of their constructions for saving labour in the transport of material.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 872.)

TAKEN all round, business was on a very reduced scale generally upon the Stock Exchange last week, a fact for which the counter attraction of Ascot was to no little extent responsible. Movements, too, were uncertain and irregular; but, happily, the end of the week developed an improving tone in some of the leading markets. On Monday, the opening showed fairly firm; but business was so very quiet that the tendency weakened. Things were not much more lively on Tuesday, with irregular movements of small magnitude either way. Weakness was apparent in Home Rails, and Americans were sensitive. On Wednesday, there was some moderate improvement, although Consols were fractionally weaker. But the most interesting feature was an advance, albeit inadequate, in the quotations of a number of secured issues of gas companies. These had too long been left standing at prices which were intelligible six months ago, when money was worth 7 per cent., but have been quite out of date for some weeks past. On Thursday, the tendency was shifty; and speculative lines were sensitive. But good class investments began to steady themselves, and then to advance. Business became brighter and more active on Friday, without any undue move to realize. Consols went up $\frac{1}{8}$, and signs of improvement in African adventures were welcomed. The cheerful tone continued on Saturday till the close. The gilt-edged division was in demand, and Consols were another $\frac{1}{4}$ up; while Home Rails, too, came in for support. In the Money Market, there was little movement. Rates very held about steady for some time with no tendency to harden, and finally became easier before the close. Business in the Gas Market was on a rather bigger scale than the week before, but not much. The tendency, however, was excellent; and, in addition to the advance in secured issues mentioned above, there were important rises in some ordinary stocks. Gaslight and Coke ordinary led the way with a gain of a couple of points, transactions advancing from 96½ to 98. Of the secured issues, the preference marked 107¾ and 108¾, and the debenture from 84 to 85. South Metropolitan was quiet and unchanged, marking from 118½ to 119½. The debenture was done at 85¼. In Commercials, the 4 per cent. changed hands at 107¾, the 3½ per cent. at 100½ free and 101, and the debenture at 82 free. In the Suburban and Provincial group, Brighton original was done at 205½ and 206½, ditto "A" at 156 and 156¾, Wandsworth "B" at 130½, and West Ham at 101½d. The Continental companies were quiet. Imperial marked from 180 to 181, ditto debenture 94½, European fully-paid 23⅛ and 23⅞, Union 113, and Tuscan 10⅜. Among the undertakings of the remoter world, Buenos Ayres changed hands at 11, Monte Video at 11½, Oriental at 143, Primitiva at 5 15/16 and 6, ditto preference at 4 15/16 to 5, ditto debenture at 92½ and 92⅝, and River Plate at from 12¾ to 13.

ELECTRICITY SUPPLY MEMORANDA.

Municipal Accounts—Fortune's Frowns—The Effects of the Coal Bill and of Metallic Filament Lamps—Shortage in Profits—An Unwelcome Legacy.

THE annual accounts of the municipal electricity undertakings are now coming to the surface a few at a time. As usual, there are some showing excellent results through excellent location; others are not of the character that could be desired by the committees and engineers in charge of the undertakings concerned. So far as the accounts have been published, there appears to be more of the indifferent kind than of that which can give satisfaction to those having responsible relations with the working. Of course, we fully recognize that last year was an exceptionally bad one, in view of the heavier coal costs; but we do not forget, too, that the deficits and the shadowy profits of the year very completely corroborate our old contention that many electricity undertakings are somewhere, in the business they are doing, cutting things much too fine in the matter of charge when the increased expenditure under one item alone can turn alleged net profits into deficiencies, or reduce them by a substantial amount. It all shows that in normal times, especially in the lower-priced business, there is not sufficient margin. There is no doubt that most of the undertakings have suffered more or less from the higher cost of coal; but there has been special reference to the subject in the reports of the electricity departments of Barrow-in-Furness, Devonport, Eastbourne, Lincoln, St. Helens, and Great Yarmouth. For example, Eastbourne spent £1250 more on coal; and Yarmouth (where a loss of £14 was made) had an increased outlay of £2500 under the same head. When we called attention to this matter on a previous occasion, one of our electrical contemporaries promptly mentioned the matter, and referred with some delight to what was considered to be the fact, that the coal bill was a matter of far less importance to the electricity station than to a gas undertaking. The short-sighted critic overlooked the bye-products of the carbonization of coal for gas making, and the fact that coke, as a rule, follows the coal market.

Coal will be cheaper in the current year; or rather so far as the new coal contracts will affect the year. But the electricity industry, like the gas industry, has to face the fact that there has not been a return to the old prices for coal, and that the coal market outlook favours no expectation of ever again touching past low-level prices. That is a fairly-well settled condition that has to be taken into account; and it is not the only one. Fortune appears to be frowning on the financial interests of the electricity industry—more particularly the municipal part—at the present time. There is the consumption reducing power of the metallic filament lamps. Effects are beginning to be traced in the accounts already published; and some of the electrical engineers frankly say they are feeling the results of the lower consumption for lighting through the more economical lamps. The Electrical Engineer of the Stepney undertaking observes that the effects of the lamps are beginning to make themselves felt on the units sold for private lighting; and at Nottingham, the report of the department points to the fact that no additional plant has been required at the generating station owing to the increased use of the metallic filament lamps. It may be that the depression of the lighting load by these lamps and the ascending day load may make a considerable difference in helping to give that straightening to the curve of output for which the electrical engineer has been constantly and sincerely longing; but it may also have another effect for which he has not been longing, and that is to prove to him the folly of having such widely different charges for different classes of business. In the accounts where the directions of increased business are distinguishable, it is very generally found to be in some other direction than in that of lighting. At Birmingham, for instance, the increase in the consumption of electricity is stated to have been due principally to the increased traction load; and the West Bromwich Electricity Committee report that the increase in their private lighting receipts last year was only £53. On the other hand, Mr. Vignoles, the Electrical Engineer of Grimsby, is one of those happy-going fellows who smiles upon the metallic filament lamp, believing that it will yield a great increase in the future in the private lighting demand. There is one little side light on the metallic filament lamp question from Finchley. In the report, referring to the use of the lamps in public lighting, it is stated that, while a better light is given, the cost of attending to them has increased from £502 to £587.

Now turning to some of the emaciated financial results of the past year of certain of the municipal undertakings, it is noticed that comparatively few of the accounts say anything about transferences to reserve and depreciation. Of course, the reason is that many of them have not the money to transfer. In quoting the following figures, it should be repeated that there are several well-favoured undertakings showing excellent results. The Aldershot concern, however, has only a net profit for the year of £76; Barrow-in-Furness has a loss of £791, as compared with a profit in the previous year of £33; Bath has a deficit of £383, and now carries a debit balance of £1276; Batley has made a net profit of £121, as against £494; Bray records a deficit of £390; Burton-on-Trent made a net profit of £1104, as compared with £794 (the "Electrical Times" puts 1 too many in, and people have no doubt congratulated the Electrical Engineer on the glorious increase from £794 to £11,104); Canterbury shows a net profit of £73, against £412 the previous year; Crewe has only a net surplus of £876; Devonport has the magnificent profit of £3 14s. 4¼d., compared with £2196 in the previous year; Dudley only boasts a net surplus of £336; Finchley bemoans a deficit of £292; Gloucester of £1412 (£1200 of which has been charitably made up by the water consumers); Grays has a balance of £228; Kendal, a deficit of £750; even Lancaster only claims a surplus of £1079; while Leigh is on the wrong side by £12. Leyton declares a balance of £936; and Lincoln of £1547, as against £3083 in 1906-7. The Marylebone Council have had to take £3000 out of the credit-balance at March 31 last; and the estimated deficiency in the current year is £6967. The Rathmines and Rathgar undertaking reports a deficit of £50, St. Helens a surplus of £267, Southport of £417, and Stepney of £1928. Sunderland records a deficit of £1908, besides their bad and doubtful debts

amounting to £2000. Swansea made sufficient profit to wipe off a deficit of £450, and leave a net profit of about £500. Taunton has a net profit of £281; and Tunbridge Wells of £1141—a drop of £314 on 1906-7, and of £759 on 1905-6. There is one curious point about the Tunbridge Wells accounts to which the "Kent and Sussex Courier" directs attention; and it is that, though the estimated quantity of electricity sold for public lighting last year was 77,042 units less than it was in 1905-6, the payment for electricity for public lighting was only £21 less. Warrington's surplus of £2213 is a decrease on the previous year of £303; while that of West Bromwich (£2030) is a decrease of £593. The Borough Treasurer here suggests that the time has arrived when provision should be made by the undertaking for depreciation and reserve. Unfortunate Yarmouth has returned to its old style, and reports a loss on last year's trading of £14.

In this conjunction, it is noted that a serious report by the District Auditor (Mr. A. Carson Roberts) on the accounts of the Electricity Department of the Woolwich Borough Council has been issued. He states that a loss of £15,744 for the year is revealed by the accounts; and the loss shown would have amounted to nearly £17,000 if loans had been raised sufficient to cover the capital expenditure as it was incurred, and a proper share of their redemption had been charged in the year. The rates will have to provide rather more than the gross earnings of the undertaking, which, apart from the charges for wiring and motors, amounted to £16,824. The rates raised in aid of the undertaking yielded £9794. But the deficiency brought forward exceeded this amount by more than £1000; and the deficiency on the accounts is £16,835. This, however, falls short of the true deficiency at that date, as no account had been taken of the proportions of standing charges which had accrued, but had not fallen due for payment, amounting to £4366, and bringing the revenue deficiency up to £21,200. The cash position was even worse by reason of the fact that the quarter's payments preceded the receipt of the year's income, and that the capital outlay had run considerably in advance of the raising of loans. The overdraft on revenue amounted to £27,887, and the over-expenditure on capital account to £16,448. A nice legacy forsooth to have from the old Council.

PERSONAL.

Mr. J. R. Brocklebank has been appointed Superintendent of the Street Mains and Lighting Department of the Manchester Corporation, in place of the late Mr. Walmsley. Mr. W. G. Gulland has been made Deputy Superintendent.

At the meeting of Metropolitan Water Board last Friday, Mr. G. S. Elliott, the Chairman of the Appeal and Assessment Committee, was elected Vice-Chairman of the Board, in succession to Mr. E. B. Barnard, M.P., who is now the Chairman.

Mr. J. B. Kent, Manager of the Wapping Works of the Commercial Gas Company, was the recipient, on Thursday, the 11th inst., of a silver tea service, presented to him by his colleagues as a mark of their esteem and regard on the occasion of his retirement, after 32 years in the Company's service.

On Wednesday, the 10th inst., at St. Mary's Church, Marylebone, the marriage was solemnized of Mr. George Wilton, the Managing-Director of the Chemical Engineering Company and the Wilton Patent Furnace Company, and Miss Daisy Beale, of Farnborough. After the ceremony there was a reception at the Central Hotel.

Last Saturday, Mr. Charles Ernest Augustus Armitage, M.A., M.B., B.Sc. (Cantab), M.R.C.S., L.R.C.P. (Lond.), of Harlesden, N.W., elder son of Mr. Charles Armitage, the Gas Engineer to the Lancaster Corporation, was married at All Saints' Church, Margaret Street, W., to Gladys E. Major, daughter of the late Mr. J. C. Major and Mrs. Major, of Wolverhampton.

The wedding of Mr. J. W. Bottomley, the Secretary and Manager of the Milnrow Gas-Works, to Miss May Naylor, the only daughter of the late Mr. William Naylor and Mrs. Naylor, of Blackpool, took place in the Hound's Hill Wesleyan Church, Blackpool, last Wednesday. After the ceremony the party were driven to the Masonic Hall, where a reception was held. Mr. and Mrs. Bottomley subsequently left to spend the honeymoon in London and Bournemouth.

Mr. A. H. Godwin, the Manager of the Watford Gas Company, has been compelled through ill-health to resign his position, which he has held for nearly 41 years. He was trained at the Wandsworth Gas-Works under Mr. H. E. Jones, and joined the Watford Company in 1867; and naturally, in his long experience, he has seen many changes in connection with the manufacture and distribution of gas. He has always devoted himself to his works, declining to enter into the wider field of gas politics; and the Company were, we think, fortunate in finding in him a Manager whose duty and pleasure were all centred in his occupation. It is not too much to say that to his efforts the present prosperous condition of the Company is largely due. Well known in the South, and highly respected for his sterling character, Mr. Godwin's many friends will wish him, in his retirement, a return of the robust health which he so long enjoyed. The Directors have appointed Mr. J. Duncan Royal, the Secretary, to be General Manager and Secretary, and Mr. T. S. Godwin, the Assistant-Manager, to be Works Manager and Engineer.

A NEW ILLUMINATING AND HEATING GAS.

Blau Gas.

At a recent meeting of the New York Section of the Society of Chemical Industry, a paper was read by Professor W. Hallock, in which he directed attention to a new gas suitable for illuminating, heating, and power purposes. The text of the paper is contained in the current number of the "Journal of the Society of Chemical Industry," from which we reproduce it.

Heretofore, it had been customary, in the case of compressed gas for illuminating purposes, to use only such gas or gas mixtures as remained gaseous even under the high pressure to which they were subjected. This condition necessarily limited the range of utilizable hydrocarbons; the tendency always being to eliminate just those gases high in carbon which are most valuable for heating and lighting. Blau set himself the problem of producing a liquid which should be a mixture of several easily volatile compounds, or of such as are vapours at ordinary temperatures, and then compressing into it large quantities of the so-called permanent gases. For example, such hydrocarbons as propane, butane, isobutane, the pentanes, propylene, butylene, &c., are readily compressed to liquids, and in this state dissolve large quantities of the permanent gases, hydrogen, methane, &c.

In this connection two very important characteristics of such a solution under pressure must be reckoned with. First, the manner of its gasification on relief of pressure; and, secondly, its commercial production. Conditions must be so arranged that the permanent gases will not all be evolved first, and then the vapours, thus changing the composition of the gas. A pressure solution must be provided, so that when the permanent gases are evolved they carry with them a constant proportion of the vapours. It is only under these conditions that the constitution of the gas will remain constant and the liquid be available. Thus, only by combining the idea of reversing the proposition and using the coercible gases under the right conditions did Blau satisfy the second requirement.

In the usual methods for the production of illuminating gas, it is customary to carry on the distillation at comparatively high temperatures, in order to break up the higher hydrocarbons referred to above; thus furnishing a larger percentage of the permanent gases. Blau carries on his distillation at lower temperatures—600° to 700° C.—where a large percentage of the easily liquefiable gases is produced, together with a smaller percentage of the permanent gases. This whole product is then put through the usual processes for purification, and then highly compressed. Under this pressure, the heavier gases liquefy, and at the same time become saturated with the permanent gases. Any excess of the latter passes off for use in any of the usual ways; for example, running the gas-engine for the compressor, and the like.

This pressure solution is then filled into steel cylinders, in which it is available for transport. The cylinders, are of all sizes, from ½ kilo. to 25 kilos. A medium-sized cylinder of 10 kilos. or 22 litres would be about 5 or 6 inches in diameter and about 3 feet high. Such a cylinder, at 15 c. per kilo., would cost $1·50, and would supply a 50-candle incandescent burner for 480 hours, or four months at the rate of four hours per day. A kerosene burner would require 120 litres, or about 32 gallons.

The specific gravity of the gas is 1·105 (air = 1); that of the liquid, 0·59 (water = 1); 1 kilo. gives 12,318 calories; 1 cubic metre, 15,349 calories.

Intensity of Light.	Consumption of Blau Gas per Hour.		
H. K.	Grammes.	Litres.	Cubic Feet.
50	21·00	17·0	0·63
100	35·00	29·0	1·07
500	122·00	98·0	3·63

Explosion Limits (Percentages).

Name of Gas.	Upper Limit.		Lower Limit.		Range.
	Air.	Gas.	Air.	Gas.	
Coal gas	93	7	81	19	12
Acetylene	98	2	51	49	47
Blau gas	96	4	92	8	4

For incandescent lighting, it is very important to have a gas of high calorific value, in order that the generation of heat may be as concentrated as possible. Concentration of heat means high temperature in the mantle; and experiment and theory agree that the radiation of a source is proportional to the fourth power of the absolute temperature. Moreover, according to Wien's displacement law, as the temperature rises, the proportions of energy available for illumination increase. For this reason, the electric arc is the most efficient source of light; and such low-temperature sources as the ordinary gas-burner or incandescent electric light are very inefficient. The researches of Lummer, Pringsheim, Wien, Boltzmann, Stefan, and others, amply prove the enormous economy of a high-temperature source of light.

GERMAN ASSOCIATION OF GAS AND WATER ENGINEERS.

FORTY-EIGHTH ANNUAL GENERAL MEETING IN BERLIN.

REVIEW OF THE PROCEEDINGS.

[Report by Our Special Representative.]

The Forty-Eighth Annual General Meeting of the parent Gas and Water Association of Germany was held last week in the Capital city of the Empire under very favourable conditions. The programme was extended by the inclusion of an extra day devoted to visits to works, so that in all five full days were given to the technical and social proceedings, instead of the four days and an evening which have sufficed for previous meetings of the Association. Perhaps the fact that Berlin offers so many attractions for a more prolonged stay, was responsible for the alteration. Be this as it may, with visits to works arranged for Monday the 15th of June, and with the last function concluding after midnight on Friday the 19th, there was every temptation to spend both the preceding and succeeding week-ends in the city; and a large proportion of the 1200 persons who attended the meeting yielded to this temptation.

Advantages of Berlin.

There are many advantages in meeting in a city second only in Europe to London and Paris in point of size, but some minor disadvantages. For instance, a meeting of 1200 representatives of an important industry excites much local interest in a relatively small town, and the municipal authorities are active in arranging for the entertainment of their visitors, who for the time are received as honoured guests. Obviously no such local interest can be roused in a great city; and Berlin had no general civic welcome for the gas and water engineers. But the engineers and other officers of the local gas-works—both the Municipality's and the Imperial Continental Gas Association's—amply atoned, by generous and kindly reception of their colleagues from afar, for any lack of civic interest in the visitors. There was one matter of deep regret, however—that the President of the Association, Herr J. Nolte, the Manager of the New Gas Company of Berlin, was prevented by illness from presiding at the sittings. His dignified presence and genial manner, so conspicuous and appreciated at last year's meeting of the German Association, and at the sitting of the International Photometric Committee at Zurich last July, were greatly missed; and many and sincere were the hopes expressed for his early recovery. Fortunately, the present Vice-Presidents of the Association (Messrs. E. Körting and W. H. Lindley) were men fitted to fill the President's place with conspicuous success; and the conduct of the sessions by them left nothing to be desired. Indeed, whether it was due to the influence of Herr Nolte's example last year, or to their innate sense of the advantage of dispatch and order in the proceedings of a busy meeting, it is certain that, to English views at least, this year's technical programme was carried through in a manner which compared very favourably with the meetings of the Association not many years ago. Whatever may be the reason, the Association is to be heartily felicitated on the improvement, without which it would have been impossible to get through this year's heavy programme in the allotted time. It was heavy *per se*; it became arduous under the conditions of temperature which prevailed. For the nonce, Berlin figured as the hottest town in central Europe; and with the thermometer recording 88° Fahr. in the shade, it is not surprising that the stress of work was severely felt by the officers and Committees of the Association on whom the brunt of it fell.

The Meeting-Place.

The technical proceedings took place in the Beethoven Hall of the "Philharmonie," of which the means of ventilation left everything to be desired. At Tuesday morning's session, the optical lantern was freely used to display the views and diagrams necessary for the elucidation of the text of the communications, and blinds and curtains were accordingly kept drawn over the windows, which could not then be opened. Other provision for ventilation appeared to be quite absent; and the large assembly congregated in the hall for the most important day's proceedings were stifled, and languished in an atmosphere which would have been a discredit to the poorest type of factory or the lowest assembly hall. Having regard to the fine proportions and the beautiful decoration of the Beethoven Hall, there is no question that its lack of means of ventilation calls insistently for remedy. On subsequent days, the windows, all on one (and that the sunny) side of the hall, were open; and there was some improvement in the atmospheric conditions within the hall. Even so, the chamber was excessively hot and stifling, and conduced to languor. Partly on this account, but perhaps more because of the large number of papers presented to the meeting, the discussions on most of them were very brief; and this record of the proceedings will therefore comprise little more than a series of reports of the contents of the more important papers. The fact that some of these were of extreme topical interest fully redeems this year's German meeting from any impeachment of dullness. As usual, the meeting assumed a cosmopolitan, or almost internationa character; for Austria, Belgium, Croatia, Denmark, England, France, Holland, Hungary, Italy, Norway, Poland, Russia, Sweden, and Switzerland were all well represented. But for the unfortunate clashing of the date of the meeting of the Institution of Gas Engineers with that of the German Association, there is no doubt that England would have been more fully represented; for one London gas engineer at least who is a familiar figure at the German meetings was absent on this occasion.

The bureau established for the purposes of the meeting opened in the louvre hall of the "Philharmonie," at 10 o'clock on the morning of Monday last week, and was at once fully engaged in distributing the programmes of the meeting and the tokens of membership. For the afternoon there were arranged six alternative visits to works in Berlin and the vicinity. Four of these visits—viz., to the Engineering Works and Foundry Company at Charlottenburg, formerly known as J. C. Freund and Co.'s works, the Pumping-Station of the suburb of Deutsch-Wilmersdorf, the power installation at the West Warehouse at Charlottenburg, and the Central Electricity Works of the Berlin Municipal Electric Supply Undertaking—have no special interest to English gas engineers; and it is not proposed to deal with them further in this report. The remaining two works—viz., the lamp-factory of Messrs. Ehrich and Graetz, and the compressor installation for high-pressure street-lighting, at the Gitschinerstrasse works of the Municipal gas undertaking of Berlin, should be of more than ordinary interest to readers of the "Journal."

A Large Lamp Works.

The lamp-works of Messrs. Ehrich and Graetz, which are on the outskirts of Berlin to the south-east—towards Rixdorf—are fully equipped for the manufacture of large numbers of petroleum lamps, heating burners, and ordinary and high-pressure incandescent gas-burners. Upwards of 15,000 hands are employed at these works, and the output of incandescent gas-burners amounts to from 7000 to 10,000 a day. It is here the famous Graetzin high-pressure inverted gas-burners are made; and the visitors to the factory last week were enabled to watch them in all stages of manufacture. The larger twin and three burner inverted lamps for street lighting were inspected with special interest, particularly those with distant lighting devices and those intended for changing over from two or three to one burner lights after the busy hours of the evening. The system of regulating and checking the bunsen flames adopted in the factory seemed to be so thorough that it is hardly conceivable that an unsound or an ill-adjusted burner can escape detection. The various stamping and cutting machines for preparing the parts of the burners were too numerous for close inspection; but they were obviously well adapted for their work, and were operated with great rapidity and nimbleness by the hands. The intelligent interest which the more skilled workmen took in the purpose of their tasks was very marked. Altogether Messrs. Ehrich and Graetz are to be congratulated on having so highly organized and perfectly equipped a factory for meeting the rapidly developing demand for high-power inverted gas-lamps.

Public Lighting of Berlin.

The compressing plant for high-pressure lighting of the Berlin Corporation may appropriately be considered in conjunction with the paper which Professor Drehschmidt, Ph.D., the Chemist to the gas undertaking, read on Tuesday morning. The compressing plant employed is established in a special building adjoining the Gitschinerstrasse. It consists of three twelve-horse power Körting gas-engines and compressors, one "Pharus" and one "Colonia" (Otto-Deutz gas-engine) compressor. There is an 18-inch gas-main from the governor-house of the gas-works to the compressor station; and this is the suction main on which the pumps draw through 5-inch connections. Each compressor discharges into a 4-inch connection, which leads to a 16-inch pressure main, which is shortly reduced to 12 inches. The pressure at the inlet of the pressure main is about 2000 millimetres (78½ inches) head of water, and it falls to about 1350 millimetres (53 inches) at the extreme point of the high-pressure distributing system. There is about 7 kilometres (about 4½ miles) length of high-pressure main laid from the Gitschinerstrasse station. It reduces gradually to 2 inches at the farthest point. The three large compressors are ultimately to be supplemented by four similar ones to meet the extension of the high-pressure system. Already 1600 inverted Graetzin high-power lamps are supplied, as well as 600 upturned Selas high-pressure burners. Each compressor is capable of delivering over 14,000 cubic feet of gas at the required initial pressure. The two smaller compressors differ essentially from the larger and from one another in the way they are governed. The "Colonia" compressor with its 4-horse power "Otto" engine is of the rotary blower type, and delivers 7000 cubic feet of gas per hour at a pressure of 53 inches. Uniformity of pressure

is secured by means of a weighted governor actuating a bye-pass return-valve. This apparatus is intended for use with either the high-pressure upturned burner of the same name, or with a special inverted burner. As to the effect of the high-pressure gas-lighting in general in the streets of Berlin, it can only be said that it is marvellously good, and seems scarcely susceptible of further improvement. Among the more important thoroughfares in which the high-pressure gas-lamps are employed with conspicuous success may be named the Königgrätzerstrasse, Anhaltstrasse, Potsdamerstrasse, and Wilhelmstrasse; while the inferiority of profuse electric arc lighting may well be realized by comparison of the aforesaid streets with the important thoroughfares, Leipzigerstrasse and Friedrichstrasse, in both of which the electric lamps have been retained up to the present. But it is now fully recognized by the civic authorities of Berlin that the arc lamp must give place to the high-pressure gas-light in all streets where the best results are desired. The standard of street lighting is very high in Berlin, so that it is obvious the time is not far distant when all the important thoroughfares of the city will be lighted by means of high-pressure gas-lamps.

This fact was emphasized by Professor Drehschmidt in his paper on the public lighting of Berlin, and in particular the high-pressure gas lighting. He pointed out that, after much labour, the high-pressure gas-lamp had been developed to a point at which it surpassed the previously unequalled electric arc lamp. The technically ignorant think it a superior type of electric lighting, for it must be remembered that when the burners are in action, the mantles are practically invisible with the unprotected eye. But the popular impression of the superiority of the new gas-lamps for street lighting is also substantiated by the results of scientific determinations of the illumination by the lights which Professor Drehschmidt carried out on the lamps established in the Potsdamerstrasse. These results indicated a high degree of uniformity of illumination, not only in the horizontal, but also in the vertical plane, which is perhaps the more important so far as busy thoroughfares are concerned. Adequate illumination of vertical surfaces is of the greatest advantage to pedestrians, and also to carmen, as people coming from opposite directions are thereby enabled readily to recognize one another, and traffic is clearly discerned. For this and other reasons Berlin will greatly extend its present large installation of high-pressure street-lamps. Dr. Drehschmidt mentioned further that Stuttgart had also found high-pressure street lighting to be very satisfactory and highly advantageous.

The programme for Monday, the 15th inst., included a reception in the evening, followed by supper in the large Assembly Hall of the "Philharmonie;" and, as usual with this opening social function, the highest conviviality prevailed. A concert had been arranged for in connection with this supper.

Welcome to the Association.

On Tuesday morning, the technical proceedings proper commenced in the Beethoven Hall. After Mr. E. Körting had made a brief introductory remark, and referred to the absence through illness of the President, Herr Nolte, a formal welcome on behalf of the civic authorities was expressed by Common Councilman Herr Namslau, who incidentally said that in the lighting of the streets as effected by the high-pressure gas-lamps in Berlin, the maximum degree of illumination which the human eye could bear with any comfort appeared to have been attained. The official welcome was confirmed in a few appropriate words by Law Counsellor Herr Cassel. Further, the President of the Association for the Promotion of Industry extended a welcome to the gas and water engineers in the name of the Technical Associations of Germany. Mr. E. Körting, in acknowledging on behalf of the Association of Gas and Water Engineers the expressions of welcome of the three previous speakers, put forth a plea for freedom of the gas industry to pursue its beneficent functions unhampered by legislative or civic restrictions. In particular, he asked that it should be restrained to the smallest extent possible by public prescriptions and ordinances, and that gas should not be made a costly commodity by the imposition of duties or artificially regulated prices for the raw materials, coal and oil. He then presented to Herr K. Kohn, the Manager of the Frankfort-on-Maine Gas Company, the Bunsen-Pettenkofer Medal which had been awarded to him the previous year, and announced that awards had been since made to Common Councillor Herr Wunder, of Leipzig, and Herr Söhren, the Manager of the Bonn Gas-Works.

Presidential Address.

Mr. E. Körting then proceeded to deliver an interesting Inaugural Address. He stated that the gas consumption in Greater Berlin for purposes other than lighting could be safely estimated at fully 50 per cent. of the total. The consumption of gas was at the present time increasing at a relatively higher rate than ever before, notwithstanding the great development which the last decade had witnessed in the use of electricity. Gas claimed the lion's share of the supply of light from central works, boasting of 81 per cent. of the total, and leaving a residue of only 19 per cent. for electric lighting. Further, of the total energy supplied from central works for heating and power development, gas claimed 77 per cent. in respect of the quantity used for cooking, heating, and power production, and so was far ahead in quantity of the electricity applied for driving motors. As compensation for the loss to the gas industry of large and rich consumers who had gone over to the use of electricity, a new and big field had been secured in the supply of gas to the working classes by means of prepayment meters. On Jan. 1 last, there were fitted in Berlin about 84,000 of these meters, the capital cost of the installation of which had been £350,000. The annual consumption of gas through them now exceeded 1,050 million cubic feet. The competition of the municipal and private gas undertakings in Berlin had conferred on the inhabitants the benefit of the lowest uniform rate of charge for gas in Germany—viz., 3s. 6d. per 1000 cubic feet; and this uniform price of gas for all purposes extended even to small villages 12 to 20 miles from the centre of the city.

Technical Development of the Berlin Gas-Works in the Last Decade.

Mr. Körting then called upon Herr Timme, the Works' Superintendent, to read the paper on this subject which had been prepared by Herr Schimming, the Manager of the Berlin Municipal gas undertaking, who was unfortunately prevented by illness from reading it himself. It would, perhaps, be more correct to say that Herr Timme gave a lecture illustrated by a very large number of statistical and other diagrams and views, which were thrown upon the screen in rapid succession. The following are some of the more generally interesting facts disclosed: The expenditure during the last ten years by the Municipality on new buildings and plant has been about £5,000,000 (exactly 97,778,978 marks); and the annual total of the balance-sheet of the gas undertaking is now £2,800,000—an amount which is only exceeded in the budgets of eight of the German states. Of the six works of the gas undertaking, the first, situated in the Stralauer Platz, had now ceased to be a manufacturing station, and was used as a central storage station and main and pipe stores. In 1897, it had a productive capacity of about 1,160,000 cubic feet per diem, which had been reduced by the following year to 70,000 cubic feet per diem. After that year gas was no longer made at these works. Views were shown of several of the stores and shops which now occupy this site. The second works is that in the Gitschinerstrasse, which had a productive capacity of 5¼ million cubic feet per diem in 1898, and now it has increased to 8½ millions per diem, including water gas. Views were shown of, *inter alia*, the coal unloading and conveying plant, a De Brouwer charging-machine, the coke-sorting plant, a naphthalene washer, and the water-gas plant at this works. The third works—viz., that in the Müllerstrasse—will shortly be abolished as a manufacturing station. Its productive capacity is now only 2,600,000 cubic feet per diem, as compared with its maximum in 1899 of 6¼ millions. The fourth works is in the Danzigerstrasse. In 1898, its productive capacity was 6,800,000 cubic feet per diem. It is now 15½ millions; and is being increased to 21 millions. Interesting views of this works were shown, among them being the carburetted water-gas plant, a retort-house, the railway waggon tip, the coke preparing plant, the electric-power station, and the elevated coke railway. The fifth works, in Schmargendorf, had in 1898 a productive capacity of 3 million cubic feet per diem, which has now been increased to 7¾ millions, and will ultimately reach 8¾ millions. This is a considerably smaller extension, however, of this works than was contemplated ten years ago, before the erection of the new works at Tegel was decided upon. Among the views shown of plant at the Schmargendorf works were the naphthalene washers, the De Brouwer conveyors, and the coke sorting and water-gas plant.

The sixth works is the new works at Tegel, which started making gas in 1905, and now have attained a productive capacity of over 12 million cubic feet per diem. This will be increased to 22¾ millions per diem, or to about a third the capacity of the Beckton works of the Gaslight and Coke Company. The comparion is made because it has been suggested in a Berlin daily newspaper that the Tegel works, when completed, will be the largest gas-works in the world. It is unnecessary, in view of the account and views of the works which were given in last week's "JOURNAL," to refer further to them now, except to say that a large party of those attending the meeting went to the works by special train in the afternoon for a tour of inspection. The most striking features disclosed to the casual visitor are the rope-driven coal conveying mono-railway which traverses the whole works, and the colossal proportions of the coal-store—at this time of year comparatively empty. The impression of walking through a spacious building over a third-of-a-mile long is not an every-day experience. Yet a second similar building is ultimately to be erected alongside the present one, in order to provide what is considered to be adequate coal storage for these works. The English gas engineer surveying the provision made must be thankful that the climatic conditions which demand it do not obtain in his own country. The housing of the gasholders also reminds him of the different conditions under which his Berlin colleagues have to work in winter time. The Berlin gas undertaking uses a large proportion of English coal; and there are in store at the present time Washington, Dean's Primrose, Ravensworth, Leversons, and Hebburn Main, as well as large quantities of the Upper Silesian "Zabrze" coal. The carburetted water-gas plant at the Tegel works comprises three paired-generator sets erected by J. Pintsch and Co.

Passing on from the details of the Tegel works, Herr Timme gave figures relating to the Berlin gas undertaking as a whole. For instance, in 1898, the mean diameter of the mains of the distributing system was 270 mm. (say, 10½ inches); now it is 305 mm. (say, 12 inches). In 1898, there were 931,500 metres (580 miles) of main laid; by 1908 the length has extended to 1,341,300 metres (nearly 834 miles). But perhaps the most striking figures were those relating to the burners in use in 1898 and

Gas Meters.

THOMAS GLOVER & CO., LTD.,

49, QUEEN VICTORIA ST., LONDON, E.C.

AND AT

BRISTOL, BIRMINGHAM, MANCHESTER, GLASGOW, & MELBOURNE

Gas Stoves.

R. & A. MAIN, LTD.,

49, QUEEN VICTORIA ST., LONDON, E.C.

AND AT

BRISTOL, BIRMINGHAM, MANCHESTER, GLASGOW, & MELBOURNE.

CLAPHAMS'

"ECLIPSE"

GAS-WORKS SPECIALITIES

at the

FRANCO-BRITISH EXHIBITION

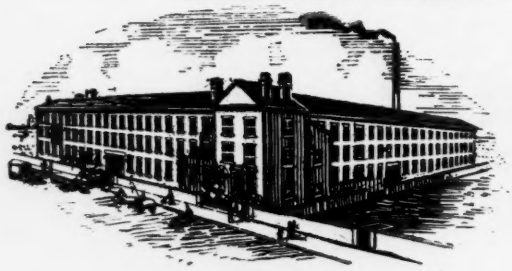
SHEPHERD'S BUSH,

BUILDING NO. 49, STAND 167,

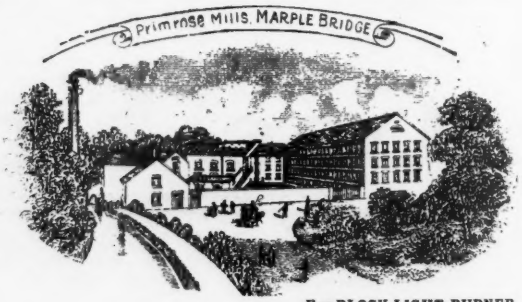
Opposite the Exhibit Arranged by the Gas Undertakings of the United Kingdom.

THE "ZEIMAR" GAS MANTLE.

Quality will always command a Market—Hence the Success of the "ZEIMAR."

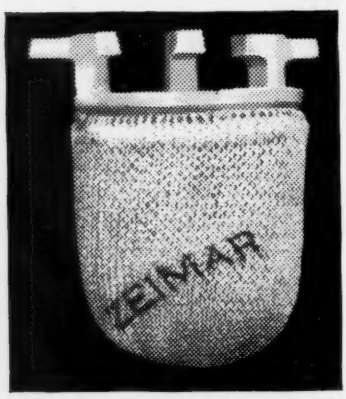


The ONLY "ALL BRITISH MADE" Gas Mantle.



For BLOCK LIGHT BURNER.

"ZEIMAR" INVERTED MANTLES.



When a Mantle Shrinks it loses its Light.

THE "ZEIMAR" NEVER SHRINKS.

A well-known Photograph,

IT SPEAKS:—

COTTON.
Best Quality Mantle, Double Woven. Actual condition after 24 hours burning.

ZEIMAR.
3-ply Ramie Mantle. Actual condition after 600 hours burning.

(COPYRIGHT).

COTTON.
Best Quality Mantle, Single Knitting. Actual condition after 24 hours burning.

Sole Manufacturers: **THE RAMIE CO., LTD. (Warburton's Patents), BREDBURY.**

now for street lighting. The ordinary burner, which preponderated in 1898, has dropped out altogether. The "C" incandescent burners have increased from 21,768 in 1898 to 28,572 at the present time. But since 1898, there have appeared on the scene 2163 high-pressure gas-burners, of which about two-thirds have inverted mantles; and these have an aggregate illuminating power of 2,068,820 candles. There are now, also, 1232 inverted burners consuming gas at the ordinary pressure. The total for the street lighting are: In 1898, 26,738 burners of all kinds, aggregating 1,670,360-candle power; and in 1908, 32,342 burners, aggregating 4,296,027-candle power. The increase in the number of street-burners is at the rate of 21 per cent. in the period; and the increase in light at the rate of 158 per cent. About 6 per cent. of the gas made at the works is consumed for public lighting in Berlin; in most German towns the proportion is higher, rising to 15·1 per cent. in the case of Hamburg.

The following is a statement of the relation of capital expenditure to the make and net profit in the Berlin gas undertaking:—

Year.	Capital per 1000 Cubic Feet.	Price of Gas per 1000 Cubic Feet.	Total Net Profit.
	£ s. d.	s. d.	£
1898	0 16 4	4 6½ for lighting 2 10 ,, other uses	485,670
1901	..	Differential prices abolished in favour of uniform price.	..
1906	0 15 3	3 6	563,489
1905	0 16 11¾	Comparative figure for London (? South Metropolitan Gas Company) works.	

This very interesting communication standing in Herr Schimming's name, was followed by a briefer one by Herr E. Meier, of Schöneberg, Berlin, dealing with coal-stores. He referred in particular to the large coal-stores at the Tegel works (*vide supra*, and last week's "JOURNAL") and a similar one at the Grasbrook Gas-Works at Hamburg. Then Professor Drehschmidt read the paper on the High-Pressure Gas Street Lighting in Berlin, of which particulars have already been given. This was followed by a paper by Herr K. Hartmann, of Steglitz, Berlin, on

Gas as a Means of Averting the Smoke Nuisance in Towns.

The author remarked that the effect of the vitiated air in large towns was shown by an increase in respiratory complaints having taken place concurrently and proportionately with the diminution in tuberculosis. A great proportion of the vitiation of the atmosphere, apart from the unavoidable emanations due to living, traffic and industry, was due to the fuel used in works. A real remedy could only be expected by reducing the number of fireplaces by the establishment of central stations. In Germany, water power has hitherto played a very small part in such a change. Electricity, however, had already done much to reduce the number of furnaces in use. For lighting, too, he considered that, from the hygienic standpoint, it was ideal; but it was much too costly for heating and fuel purposes. The introduction of gas for lighting purposes in small households through the agency of the prepayment meter had effected a great hygienic advance in that it had been followed by the adoption of gas for heating and cooking in the same houses. It was eminently desirable that all coal-ranges should be abolished as soon as possible from the kitchen. Hitherto, however, gas had not done much in the heating of rooms; and improvement was needed in this respect. But the prevention of the smoke nuisance had been greatly advanced by the use of gas for developing power in explosion engines. The iron industry has adopted the gas-engine for the production of power. There is at the time in Germany 500,000-horse power generated from blast-furnace gas; and this use of the large gas-engine is equivalent to a saving of 3½ million pounds sterling annually on fuel. A million horse power more seems likely to be similarly obtained. Coal firing is being gradually but surely suppressed, and the central stations for generating power are being established right outside the towns. So far as the application of coal gas is concerned, a reduction of 3d. to 7d. per 1000 cubic feet in the price is much to be desired.

Other Papers, Visits, &c.

There was for the Tuesday an alternative to the visit of inspection of the Tegel Gas-Works—viz., a visit to the Berlin Water-Works at Friedrichshagen, on the Müggel Lake. In the evening there was a social gathering at the principal restaurant in the Zoological Gardens, where a newly-born hippopotamus found a large circle of admirers.

Wednesday morning was devoted to communications dealing with water supply, of the more important of which some particulars will be given next week. For the afternoon, there was a visit to the Exhibition of German Shipbuilding, in which the Kaiser has lately displayed so great an interest; and in the evening the "Wintergarten" Theatre of Varieties had been reserved solely for the gas and water men, who witnessed a gala performance there, and subsequently gathered together in the adjacent large "Zum Heidelberger" restaurant for supper.

On Thursday morning, four important carbonizing papers were read in succession—"Preliminary Remarks on the Latest Development of Gas-Making Settings," by Mr. E. Körting; "Experiences with the Working of Vertical Retorts," by Herr A. Weiss, the Engineer of the Zurich Gas-Works; "Further Experiences with the Carbonizing Chambers at the Munich Gas-Works," by Herr H. Ries, the Manager of the works; and a report by Dr. H. Bunte on "Efficiency Trials of the Vertical Retort-Settings at the Mariendorf (Berlin) and Zurich Gas-Works." Of these, slightly condensed translations of Herr Weiss's paper and that of Herr Reis appear on other pages of to-day's "JOURNAL;" and similar translations of the other papers will be given next week.

Then followed the reception of the reports of the Technical Committees of the Association, of which also abstract translations have had to be held over. The Committees were afterwards re-appointed, the accounts of the Association were presented and approved, and Mr. Körting, of Berlin, was elected President for next year. Herr H. Prenger, the Manager of the Cologne Gas-Works, was chosen to fill the position of Vice-President rendered vacant by Mr. Körting's elevation.

Frankfort-on-the-Maine was selected as the place for next year's meeting; and a suggestion was made, but only tentatively considered, that the meeting of 1910 should be at Munich.

On Thursday afternoon, there was a concert in the Beethoven Hall, followed by the banquet in the Grand Hall of the "Philharmonie." The banquet was over by midnight; but the subsequent ball went on gaily for many hours. Yet on Friday morning, at 9 to 10.30, six alternate visits of inspections to works started; and in the afternoon the members travelled by special train to Potsdam, and thence in five steamboats on the Havel and Schwielow lakes to Werder. Supper was served in the "Bismarksböhe" restaurant at the latter place; and there were then fireworks and illuminations. The return by special train from Werder to Berlin was made about midnight; and with this the successful forty-eighth annual gathering of the German Association came to a conclusion. But members of the Council and many others had again to be up and doing on the morrow, for their English colleagues to the number of eighty odd had arrived in Berlin on the Friday evening, and awaited conduct through the gas-works of which the Berlin Corporation and the Imperial Continental Gas Association are very justly proud.

The New Gas-Cooker for Boarding-Houses.

With their usual enterprise, Messrs. John Wright and Co. have placed on the market a new type of apparatus in the shape of a gas-cooker specially designed for use in boarding-houses and the smaller class of hotels. The unique advantages of this new apparatus (which they have named the "Bordo") over the ordinary gas-cooker, for the particular purpose for which it is designed, should undoubtedly popularize the use of gas for cooking in boarding-house establishments, and thus be the means of augmenting the sale of gas for those undertakings who add the "Bordo" to their lists. The new apparatus meets the peculiar requirements of boarding-house establishments in a degree quite impossible with the ordinary gas-cooker. The "Bordo" is no higher, and takes up little more space than the usual type, yet its oven and hot-plate capacity are altogether greater, so that it can easily cope with sudden extra demands. Another advantage, the novelty and utility of which will at once strike the practical mind, is that for the convenience of placing the cooker in position, the oven may be readily taken apart by simply removing a few screws. We understand Messrs. Wright and Co. have listed the "Bordo" at the same price as their largest size "New Century Eureka."

A concrete tank at the San Antonio Gas-Works has been in service for three years, holding heavy Texas oil without showing any leakage whatever, though there is a general belief that oil destroys the cohesion of concrete.

According to an article in the "Belfast News Letter," the exports of ramie from China to Europe in 1897 amounted to only about 2000 tons. In 1902, China shipped, according to Customs returns, to Japan and Hong Kong 4875 tons, to Germany 1161 tons, to France 921 tons, to Great Britain 228 tons, and to the United States 25 tons of China grass, or a gross total of 8433 tons. Since that date, the opening of a few new factories, and the universal adoption of the fibre in place of cotton and silk for weaving the bases of incandescent gas-mantles, has created a very much larger demand for the product, so that last year's exports can be fairly estimated at from 11,000 to 12,000 tons.

At Cambridge, last Wednesday, Lord Rayleigh, the Chief Gas Examiner for the Metropolis, was formally installed as Chancellor of the University, in succession to the late Duke of Devonshire. His selection for this high office was notified in the "JOURNAL" some weeks ago. At the luncheon in connection with the event, an announcement was made by Sir Andrew Noble that it had occurred to several of Lord Rayleigh's friends who are not resident members of the University that some mode of expression should be afforded to the gratification of the scientific world on his election as Chancellor, which would at the same time serve as a mark of recognition of the great obligations to his example and influence under which British science had rested for many years. They had, therefore, arranged to offer to the University a fund large enough to provide an annual award, in such manner as Lord Rayleigh might select, to be associated with the name of the Chancellor in those branches of knowledge in which he is pre-eminent.

EXPERIENCES IN WORKING VERTICAL RETORTS.

By Herr A. Weiss, Engineer of the Zurich Gas-Works.

[Abstract Translation of a Paper presented at the Meeting of the German Association of Gas Engineers in Berlin, June 16 to 18.]

The selection of the right, or economically proper, carbonizing retort or chamber is such an important question for gas-works that the author feels justified in presenting this communication, notwithstanding the abundance of other recent and simultaneous publications dealing with the topic from one or other aspect. He has in view the requirements of gas-works of moderate or large size, by which he means works with an annual output of more than 140 million cubic feet of gas. For such works, the use of the new types of settings, in conjunction with the mechanical transport of coal and coke, is not only appropriate but is remunerative. Some four or five years ago, the choice lay merely between horizontal retorts with charging and drawing machinery and inclined retorts. But now there are also vertical retort settings, vertical chamber settings, and large and special carbonizing chambers. It is not surprising therefore that the scientific and progressive gas manager finds it now more difficult to arrive at a decision as to the setting which he shall adopt.

Before proceeding to narrate the experiences gained at Zurich with vertical retorts, it will be useful to refer to the present conditions of gas supply in that town. The consumption of gas showed so great an increase that towards the end of 1904 the Corporation found it necessary to vote a sum adequate for the extension of the works to a productive capacity of at least 4¼ million feet per diem. Up to last autumn, the gas was made entirely in inclined retorts, the installation of which comprised four benches, each containing eight beds of nine retorts 11·7 feet long. These retorts had given such good results, and proved so durable, that there seemed no reason for taking up another system. The extensions decided upon in 1904 comprised the erection of two more benches of inclined retorts, but the latter were 19·7 feet long. The plans were got out; and the erection of the retort-settings should have been started during 1905. But about this time, Dr. Bueb published the results obtained with his vertical retort-settings at Dessau. These seemed generally so favourable that, notwithstanding the comparative want of experience in regard to the durability, &c., of the retorts, it was decided to drop the plans for the new installation of inclined retorts at Zurich, and erect vertical retort plant instead. This decision was supported by the expert opinion of Professor Lunge, of Zurich, which was taken on the matter, and also by practical tests which were made at Dessau for the Zurich gas undertaking with Saar coal from the Heinitz pit.

The vertical retort installation erected at Zurich comprises two benches, each consisting of five beds of ten retorts, 4 metres (13 ft. 1½ in.) in length. Each bench has its independent chimney stack. The coal and coke receptacles are planned to serve for 5-metre vertical retorts in case it should later on be found advisable to replace the 4-metre retorts by 5-metre ones. The benches are equipped for steam injection for the production of water gas; and a front retort in one bed and a back retort in another bed are connected with an experimental gas-works adjoining the retort-house. It is therefore possible with this plant to carry on parallel tests with single small retorts and with the large works' plant making 1,400,000 to 1,700,000 cubic feet per diem while in full and routine working. This arrangement is specially valuable for testing the behaviour of different kinds of coal in vertical retorts under practical conditions of use. So far as the author is aware, there is no similar experimental installation elsewhere; and it will be willingly made available for research work for his colleagues in the gas industry.

The coke is carried away by De Brouwer conveying troughs, which are placed in a passage beneath the settings through which a workman can pass to carry out repairs at any time. The installation of vertical retorts has been in full work for about eight months. Notwithstanding the comparative shortness of this time, the plant is of special interest, because it embodies improvements which even up to the last were carried out as a consequence of the experience gained with the earlier vertical retort-settings at other works. In particular, the author has to thank Mr. E. Körting for many valuable hints. At Zurich the coal carbonized is about two-thirds from the Saar and one-third from the Ruhr district of Germany. The behaviour of Saar coal in vertical retorts is specially important for Middle and South Germany and Switzerland. Extended trials have been made both with Saar and with Ruhr coal; and it may be said at once that both kinds have answered well in the vertical retorts. On the large scale, Herr Prenger, of Cologne, has made exhaustive trials, of which the results have been reported recently ["Journal," *ante*, p. 562]. His observations in regard to the behaviour of the settings and their ease of control and manipulation are generally confirmed by the author's experience.

Before proceeding to a thorough test of each kind of coal in regard to its adaptability for carbonization in the vertical retort, both with and without introduction of steam, a preliminary series of tests was made in February and March last; and the results obtained therein were used as the basis for the arrangements for the subsequent series. The first series will be referred to as the preliminary trials. They were carried out with ten beds of ten retorts, and fifty retorts were charged at a time. Observations were made of the yields of gas and coke, and their quality, illuminating and heating values (determined at 20 minute intervals), and of the fuel consumed in heating the settings. In regard to the latter, distinction has to be made between the working with and the working without the admission of steam. When steam is used, the fuel consumption must be stated per 1000 cubic feet of gas made, and not per ton of coal carbonized. The Saar coal consisted of a mixture of cobbles and No. I. and No. II. nuts; the Ruhr coal of No. I. and No. II. nuts, as used ordinarily at the Zurich works. There were 63 charges made. Further, however, some trials were carried out with Saar smalls, Ruhr Nos. III. and IV. nuts, and Ruhr unsorted coal.

The preliminary trials with Saar coal extended over seven days, and consisted of thirty chargings at intervals of 4 hours 40 mins. The coal used was mixed cobbles and Nos. I. and II. nuts; and the period of carbonization was 9 hours 20 minutes. This first series, however, was unfortunately marred by the primary air supply being too small, so that the settings were not hot enough. The result was that the fuel consumption appeared to be low per ton of coal carbonized, but not low per 1000 cubic feet of gas made. Though the air supply was increased on the fourth day, the heats did not rise sufficiently until after the series was concluded. Thus, though the fuel consumption increased in the last three days, it had not time to take effect on the make of gas; so that the fuel consumed per 1000 cubic feet of gas made was high. The temperature of the chimney gas was continuously much higher than promised by the contractors. During the first ten chargings, air was introduced; but deduction is made therefor in calculating the yield and quality of the gas. The air appeared to have little effect on the calorific value, but a considerable influence on the illuminating power of the gas. The more important figures obtained in this series of trials are shown in the first three lines of the annexed table.

The second series of trials were made with a similar mixture of cobbles and Nos. I. and II. nuts of Saar coal. The results are given in the fourth and fifth lines of the table. These trials comprised ten chargings; and the yield of gas was higher than in the first series, but the quality was naturally somewhat lower.

The third series consisted of only one trial with Saar coal smalls; and only two chargings were made. The coal was damp, and contained a high proportion of ash. The dampness of the coal put heavier work on the condensing plant, as shortly after charging the temperature at the inlet of the condenser rose to 80° C., as compared with about 65° C. ordinarily. The Saar "smalls," notwithstanding their low price, are shown by the low yield recorded in the sixth line of the table to be unsuitable for use, apart from the fact that they can scarcely be handled by the conveying plant in their damp state.

The fourth series of trials was with Ruhr nuts Nos. I. and II., and comprised seventeen chargings at a good temperature, with correspondingly satisfactory results. The somewhat higher consumption of fuel is due to the greater difficulty with which Ruhr coal is in any case carbonized. The nuts used were, however, a good gas coal. The results obtained are given in the seventh and eighth lines of the table.

The fifth series was made with Nos. III. and IV. Ruhr nuts, and the sixth with Ruhr coal as obtained from the pit. The results are recorded in the ninth and tenth lines of the table. Only two charges were made in each case, and the heats were high; but the fuel consumption, though higher than in the two preceding series, was not exactly determined.

After the installation had been taken over by the gas undertaking, a considerably higher make per diem was obtained than previously, because the period of carbonization for Saar coal was reduced to 8½ hours. Two trials were therefore made under these conditions; and in the second steam was introduced for half-an-hour. The results are recorded in the eleventh and twelfth lines of the table. The high heats used entailed a greater consumption of fuel. The yield of gas per ton was lower; and the financial result of this mode of working was therefore worse. It appears also from the low make of water gas that the coal was not completely carbonized.

Much was learnt from these preliminary trials, and some valuable indications were obtained for guidance in the later work, especially in regard to the heats of the settings, both as concerns the make of gas and the behaviour of the material of the retorts and settings. The chargings have now been differently apportioned; and 25 retorts of a bench are charged every 2½ hours, instead of 50 retorts every 4 hrs. 40 mins. This change made the demand on the boilers more uniform, as well as the work of the stokers. Some changes were made in the gas-flues, so that the heats of the settings were generally somewhat higher and more constant, and the individual retorts more uniformly heated.

After the vertical retorts had been in use for some time under these new conditions, it was decided to proceed with the carrying out of a second conclusive series of trials with Saar coal. There was no doubt that in the preliminary trials the Saar coal had been carbonized at too low a temperature, and that better results could be obtained with it. It was suggested that the Zurich plant might with advantage be put at the disposal of the Instructional and Experimental Gas-Works Committee of the German Association for the supervision of these trials; and the proposal was gladly acceded to by the Zurich authorities. The results of the trials made under these auspices are reported in detail by Professor H. Bunte in a separate communication to

Preliminary Trials with Ten Beds of Ten Four-Metre Vertical Retorts.

Trial No. and Description of Coal.	Number of Chargings.	Gas Made. Cubic Feet at 60° Fahr. and 30 ins. Bar. (Saturated.) Per 24 Hours.	Per Ton of Coal. As Used.	Per Ton of Coal. Calculated for Dry Coal.	Net Calorific Power B.Th.U. per Cubic Foot at 60° Fahr. and 30 ins. Bar.	Illuminating Power in Slit Burner at 5·3 Cub. Ft. per Hour. Candles per 5 Cub. Ft. at 60° Fahr. and 30 ins. Bar.	Coke. Yield Per Cent. of Coal.	Coke. Ash Present Per Cent.	Fuel (Coke) Consumed. Per 1000 Cub. Ft. at 60° Fahr. and 30 ins. Bar. of Gas Made. Pounds.	Fuel (Coke) Consumed. Ash Present Per Cent.	Coal Yields by Crucible Test. Per Cent. Moisture.	Ash.	Coke.	Volatile Matter Exclusive of Water.	Temperature in Degrees Centigrade of Setting at the Bottom.	Middle.	Top.	Exit Flue.	Remarks.
I. Saar	10	1,417,700	10,944	11,267	556	9·2	67·6	12·3	26·2	10·9	2·9	8·4	52·9	34·2	1170	1067	1002	567	Air admitted, but results calculated to air-free gas.
II. ,,	9	1,453,600	11,231	11,554	549	10·4			29·9						1168	1086	1023		No air admitted.
III. ,,	11	1,458,900	10,944	11,267	540	9·9													Steam admitted for one hour.
IV. ,,	6	1,530,500	11,698	12,057	527	8·9	68·4	13·9	26·1	11·6	3·1	9·2	63·9	33·0	1227	1161	1095	603	No steam.
V. ,,	4	1,595,200	12,236	12,631	522	8·0			24·9										Steam for 1 hr.
VI. ,, (smalls)	2	1,252,700	9,509	10,119	517	7·5	67·0	15·8	..	..	9·3	11·1	61·6	29·1	1344	1279	—	—	No steam.
VII. Ruhr.	11	1,542,400	11,949	12,523	516	8·0	68·2	8·7	28·5	9·7	4·7	5·7	66·3	29·0	1319	1282	—	612	No steam.
VIII. ,,	6	1,606,600	12,631	13,241	509	6·3			27·0										Steam for 1 hr.
IX. ,,	2	1,502,300	12,272	12,954	514	7·8	69·5	9·0	..	..	5·3	6·2	65·5	29·2	1388	1352	—	—	No steam.
X. ,,	2	1,518,000	11,770	12,236	518	7·7	70·9	15·9	..	..	3·8	8·6	66·3	29·9	1373	1318	—	—	No steam.
XI. Saar	2	1,617,800	11,447	11,770	532	9·8	69·0	11·9	..	..	2·9	7·5	64·0	33·1	1325	1276	—	594	No steam.
XII. ,,	2	1,658,500	11,662	11,985	536	9·4	66·5	9·6	..	..					1324	1283	—	—	Steam admitted for ½ hour.

the meeting. It may, however, here be observed that they proved highly satisfactory, and surpassed expectations. It has been found that the Saar coal could give better results. For instance, there were carbonized in all 690·6 metric tons of Saar coal, of which 339·2 tons were gasified with admission of some steam, and 351·4 tons with no steam. The make of gas at 60° Fahr. and 30 inches per ton of coal amounted to:—

With steam	14,030 cubic feet.
Without steam	12,042 ,,

as compared with 10,944 and 11,087 cubic feet respectively in the preliminary trials, in which there is no doubt the heats were too low. It is specially interesting to observe that, in both the final and the preliminary trials at Zurich, and in trials made at Cologne, while the yield of gas is practically identical from Saar and Ruhr coal, Saar coal always affords gas of higher calorific value.

All observations, both at Zurich and at Cologne, point to much more favourable results being got, both from Saar and Ruhr coal, than had ever been obtained from such coal in horizontal and inclined retorts. The following is a statement of the periods which have now been decided upon for working off the coal, with some margin for variation in the degree of purity and moistness of the coal.

> Working without steam, Saar coal is worked off in from 9 to 10 hours, or, on an average, 9½ hours; Ruhr coal, from 9½ to 10½ hours, or, on an average, 10 hours. Working with steam, one hour longer is allowed; making the average time for Saar coal 10½ hours, and for Ruhr coal 11 hours, for 1½ hours of which periods steam is introduced.

The necessity for the use of a mixture of nuts and cobbles has not been substantiated by the Zurich trials; indeed, the rather dusty Ruhr coal, just as obtained from the pit, answered fairly well. The increase of pressure directly after charging the retorts never exceeded 24-10ths, and it has never been necessary at Zurich to sprinkle the exit-pipe with gas liquor.

In order to ascertain the behaviour of the retorts when pressed to give a big output—not per ton of coal, but per retort—Saar coal was carbonized for a week in 8½-hour charges. No steam was introduced, and the retorts were scurfed as usual. The ten beds (100 retorts) yielded, on an average, 16,950 cubic feet per retort, which is 8 to 10 per cent. more than the normal output. Such an increase is not possible with horizontal and inclined retorts for any considerable period, as the heats of the settings cannot be maintained high enough. Thus there is with vertical retorts a reserve of productive capacity, apart from the use of steam, which enables the output to be increased to a relatively large extent at any time without altering the number of retorts in action. Thus, by at one time shortening the interval between chargings by (say) half-an-hour, or by lengthening it and making a higher proportion of water gas, it is possible to meet the fluctuations in the demand for gas without putting other retorts under fire. No standard rule can be made for the quantity of steam which should be introduced, as it must vary with the quality of the coal and the local conditions of gas supply.

Passing on to the labour required to attend the settings, in the Zurich works the eight-hour shift system prevails for all engineers and stokers, or men engaged in continuous work; while for the labourers and others a nine-hour day had been introduced in the previous autumn. For working the vertical retorts there are required two men per shift, engaged thus: (1) Charging and discharging the retorts, viz., $3 \times 25 = 75$ retorts to be charged per shift; (2) charging the producers once every eight hours; (3) clinkering the furnaces once every 36 hours, which gives three or four furnaces to be clinkered each shift; and (4) keeping the retort-house clean and in order. This makes the actual working time per shift five hours, distributed thus:

Charging 75 retorts	occupies	120 minutes
Charging producers	,,	40 ,,
Clinkering furnaces (3×30 minutes)	,,	90 ,,
Cleaning up, &c.	,,	50 ,,
Total		300 minutes

Further, ordinary labourers are engaged as follows: Cleaning out the gas exit-pipes, with Saar coal once weekly, and with Ruhr coal once every four days, in each case occupying two men half-a-day = 9 hours in all. Lubricating and keeping in order the levers, two men half-a-day a week = 9 hours. Changing and cleaning the pitch-pots of the hydraulic main once every four days, occupying two men half-a-day = 9 hours. Labourers are also engaged in bringing up the coke for the furnaces and scurfing the retorts. The retorts have to be scurfed regularly once a month; otherwise the block of coke does not slide out of its own accord. If less than ten beds of retorts are in action, part or all of this work can be carried out by the stokers. But for the full plant, the work per week is as follows:—

Six stokers, for eight hours for seven days	336 hours
Cleaning out gas exit-pipes	9 ,,
Lubricating, &c., levers	9 ,,
Hydraulic main	16 ,,
Coke-tending, one man nine hours a day	63 ,,
Total per week	433 hours

This is equal to about 62 hours, or 6½ men, per diem. Thus the average make of gas per man per eight-hour shift is about 247,000 cubic feet, and the wages average about 2·95d. per 1000 cubic feet of gas made; or allowing for absence through illness, leave, holidays, and military service, about 3·25d. The rate of pay is 7·68d. per hour for stokers, and 5·28d. per hour for labourers, with pay-and-a-half for Sunday work.

The make per man compared with other systems of working is:

	Cubic Feet.
Horizontal retorts and manual charging	per 12-hour day, 18,700
Inclined retorts 11 ft. 6 in. long	,, 10 ,, ,, 63,600
,, ,, ,,	,, 8 ,, ,, 57,600
Vertical retorts	,, 8 ,, ,, 247,000

The gradual ousting of human labour which modern systems of carbonizing coal have effected in the course of a decade is most striking. One man now in an eight-hour shift suffices, with less strenuous labour, to make more gas than eleven men in eight

hour shifts made with horizontal retorts and manual stoking ten years ago, and four times more than with inclined retorts. This fact is not only of financial importance, but it makes the larger gas-works independent of the favour of the workmen, since a mere handful of men can keep the largest works in action.

In regard to bye-products, the coke is harder and firmer than that from horizontal and inclined retorts, and consequently it makes less breeze. But the coke from the Ruhr coal stands the steam much better than that from Saar coal; and it may be well to give the latter more cautious treatment. The Ruhr coke is considerably superior to the Saar coke from the vertical retorts, and closely resembles that from the Ruhr coke-ovens. In the opinion of Professor Constam, who is Director of the Swiss State Fuel-Testing Laboratory at Zurich, the vertical retort coke from Ruhr coal is equal in value to the Ruhr patent oven coke, on the basis of equal ash-content. This is a point of great importance, as the Swiss gas coke has hitherto suffered from the competition of the superior Ruhr coke which is imported into Switzerland. But an attempt to obtain a higher price for the vertical retort coke than for ordinary gas coke did not prove very successful in Zurich, partly because the stoves adapted for gas coke needed adaptation for burning it to best advantage, and partly because last year the coal which had to be used in the retorts contained often 20 per cent. and upwards of ash. But it should soon become better appreciated.

The Saar coal showed a diminution of 40 to 60 per cent. in the cyanogen in the gas; the amount varying according to the quantity of steam introduced. Ruhr coal yielded in the washers about 40 per cent. more cyanogen than the Saar coal. With both coals, about 30 per cent. less naphthalene was formed. The steam injected was taken from the central boiler plant on the works; but the quantity was determined precisely, and found to be 4960 lbs. per twenty-four hours. The boilers are fired with coke breeze, and the evaporation is 5·8 lbs. per pound, so that the fuel consumed per twenty-four hours steam consumption amounts to 855 lbs. At 8s. per ton value for breeze, the cost, including the water, is 3s. 1½d. per twenty-four hours, or only 0·00025d. per 1000 cubic feet of coal gas made. This is a negligible charge. The water evaporated in the producer amounts to 0·75 lb. per pound of carbon in the fuel charged into the producer.

As regards the cost of the installation of vertical retorts, the author would refer to the figures given by Mr. E. Körting in the "JOURNAL" for Jan. 14 last. The retort-house for the vertical retorts was, however, erected much more cheaply than that planned for inclined retorts; while the cost of coal and coke conveying plant was about the same. The settings themselves cost about 10 per cent. more than inclined retort settings of the same productive capacity. The vertical retort is therefore also more economical in respect of first cost. There are, however, some points to which the firm who erect the vertical settings should give attention. The heat radiated from the settings is less than from inclines; but it seems clear that the heat radiated from the top of the bench could be reduced without considerable expenditure by packing the masonry and the lids of the retorts. The coke for the producers is conveyed to and fro horizontally and vertically before it ultimately reaches the producer. Economy of fuel and in the wages and conveying plant could be achieved by arranging to convey the hot coke as discharged from the retorts by the shortest route direct to the producers. The coke-conveying troughs are provided with one or two vapour flues for carrying off as rapidly as possible the quickly evolved steam. But these flues are generally too small; and experiments have satisfied the author that they only fulfil their purpose adequately when their cross-section is at least three times that of the coke-conveying trough. In spite of these criticisms, it must be emphasized that the Zurich plant has surpassed expectations.

The financial side must not be ignored. Let it be assumed that the plant, comprising ten beds, has been in use a year. Owing to the make per ton of coal being increased, as compared with inclined retorts, in the ratio of 76 : 61, it will be found that the Zurich Gas-Works would require only 41,300 metric tons of coal, compared with 51,500 tons with inclined retorts. There is thus a saving of 10,200 metric tons of coal per annum, which at Swiss prices means at least £13,200, or nearly £24 per million cubic feet of gas made. The wages paid last year in connection with the inclined retorts amounted to £7 17s. per million. As, however, the productive capacity per man is now more than five times as great, the wages paid per million cubic feet of gas made in vertical retorts will be about £1 10s.; thus showing a saving of £6 7s. Adding the saving in coal, the total amount saved is £24 + £6 7s. = £30 7s. per million cubic feet; and even if from this sum half is deducted for the lower returns from bye-products, there would remain a net saving of about £15. To works of the size of those at Zurich, this means a saving of £8000 per annum. In this estimate, no account has been taken of the secondary advantages, such as the better quality of the coke and tar and the higher yield of ammonia. Even if it should prove that the life of vertical retorts is shorter than that of others (though we do not yet know that this is the case), nevertheless the economical superiority of the vertical retort will still be substantial. So far as Switzerland is concerned, this retort has put the gas industry in a good position to compete with the electricity which is about to be derived from water power; and consequently those who have been instrumental in breaking away from the old lines in developing the vertical retort deserve the warmest thanks of Swiss gas engineers.

FURTHER EXPERIENCE WITH THE CARBONIZING CHAMBERS AT THE MUNICH GAS-WORKS.

By Herr H. RIES, the Manager of the Works.

[Abstract Translation of a Paper read before the Meeting of the German Association of Gas Engineers, Berlin, June 18.]

The lively interest which is being taken in the further evolution of gas-making plant in Germany and abroad is a sign of the great need which is experienced on all sides of improvement with a view to meeting the growth of the industry. The new settings are brought forward largely on social grounds—with the object of lightening and reducing manual labour; but they also ought to diminish the dependence of the management of a gas-works on the goodwill of the workmen, which becomes more pronounced as the numbers employed increase. The only way of meeting these requirements seemed to be an enlargement of the carbonizing chambers, and an extension of the time of carbonization; but experiments made at first in this direction did not succeed, and it was out of the question to adopt the coke-oven forthwith in gas-works.

When the author approached the problem, he regarded it from the point of view that the make of gas might even be reduced below that obtained in gas-retorts, provided reliability and independence in working could be attained, and the retort-house work, not infrequently described as murderous, could be at the same time redeemed from that impeachment. This point of view was taken also by Dr. von Oechelhaeuser, when a few years ago he exhibited the Dessau vertical retorts to the author. Some further development, however, has afforded the gratifying result, that the new systems of settings fully answer requirements, not only in respect of the labour conditions, but also in regard to the yield and the quality of the gas and bye-products. Thus the early fears in respect thereto have been dissipated.

The author first referred to carbonization in large chambers in a communication to the meeting of Bavarian Gas and Water Engineers in 1903; and the results he quoted then, though not quite satisfactory, indicated that the way followed was right in principle. Since then the vertical retort and chamber settings of similar or different construction to those at Munich have been brought out. The principle clearly disclosed by the Munich and Dessau trials can no longer be disputed as being correct. The results indicate that not only must the new systems of settings entirely displace the former carbonizing retorts, but that they carry with them a large number of collateral advantages of extreme social and economical importance. Indeed, the development has reached the stage when the only question remaining to be answered is which of the new settings is the best, and by which of the systems can the most economical working be attained?

We have indeed entered upon an era of keen competition between the different new systems of settings, similar to that which prevailed years ago between the various systems of regenerative retort-settings, when similarly also each inventor held his own to be indisputably the best. But the practical results attained by the vertical retorts and chamber carbonizers, as already published, furnish valuable data for comparison; and in particular—as resting on similar bases—may be instanced the results lately published by Herr Prenger for the vertical retorts at the Cologne Gas-Works, and those given by the author and Dr. Bunte at last year's meeting of the German Association for the Munich chambers (see "JOURNAL," *ante* p. 562 and Vol. XCVIII., p. 810).

The author has lately been frequently approached by engineers who were undecided which new setting to adopt, and no doubt many inquirers have been surprised that he has not unreservedly pleaded for the adoption of the Munich chambers. But his caution has been dictated by the fact that the Munich chambers so far in use have had a productive capacity of only 95,000 cubic feet per diem per setting, and an existence so far of only a year and three-quarters. Large installations have not hitherto existed. But now Hamburg has erected chamber settings of a capacity of 175,000 cubic feet per diem each, and has just brought them into use; and some of 210,000 cubic feet per diem productive capacity have been erected at the new gas-works at Munich, and should come into use during the winter. Soon, therefore, the results of these larger settings will be available. As to the existing Munich beds of chambers, they have been in use continuously since Oct. 6, 1906, except for a short time when an inspection and a few alterations were made. They have been seen by a large number of gas engineers from at home and abroad. The make of gas per setting has improved since the results were published last year, as a consequence of the alterations made; but the author cannot give precise figures, because the trials for the purpose of obtaining a new record similar to that given last year had to be interrupted owing to the work of erecting the new settings. But the chambers were placed at the disposal of, *inter alia*, the Berlin gas undertaking, for comparative trials of the coals which are carbonized there, and the results thus obtained by Professor Drehschmidt should be interesting.*

The settings are structurally, after over 500 days use, in a very satisfactory state. The base of the chambers, which must be in a level and smooth condition in order that the block of coke may

* The figures in question will be given next week in a comparative table.—ED. J.G.L.

slide out readily, has remained free from unevenness or sinking in all the chambers. As the walls are erected on this base, they also show no sign of sinking; and the joints have remained good. There has naturally been a slight enlargement owing to temperature fluctuations of the mortised joints and grooves; and there are a few cracks in the walls, but not such as to have any bad influence on the working, as they soon become closed up with scurf, and when the settings are let down could be readily filled in, or particular blocks be replaced. The chambers are sound when in action, as, even under a pressure of 8-10ths, there are no leakages of gas outwards, and the maintenance of a positive pressure of 2-10ths to 4-10ths inside precludes the inflow of air or furnace gases through the walls. The lids or doors shut satisfactorily, and the charging and discharging arrangements have answered perfectly. Ordinary inspection served to prevent any interruption through blocked ascension pipes or hydraulic main. The removal of scurf was effected without difficulty in 30 to 40 minutes per chamber. The working proceeds with the same customary regularity as with ordinary settings. Notwithstanding the delay caused by the absence of machinery for removing the coke, five beds, containing fifteen chambers in all, are charged and discharged in 2½ hours. So far, there have been no mishaps.

It may now be well to refer to comments made by Dr. Bueb last year in an article entitled "Vertical Retorts *v.* Carbonizing Chambers" (see "JOURNAL," Vol. XCIX. p. 563), on the latter. He thinks the Munich chambers differ from coke-ovens only in being inclined, and that their advantage is limited to the coke sliding out when the lower door is opened. There is the disadvantage that suitable coal cannot be pressed in in order to produce good metallurgical coke. But, as a fact, the Munich chamber differs greatly from the coke-oven in other points as well as its inclined position. The coke-oven is heated by coal gas, and so leaves only a portion of the gas evolved available for other uses. The quality of the gas made by it is unimportant, and is not considered in the construction of the oven, which solely aims at producing much, and hard, coke. The Munich chamber, however, yields gas throughout of good quality. It does not aim at producing metallurgical coke, but coke of good uniform quality suitable for household use. Moreover, the principle of the gas making in the Munich chamber is not the same as in a coke-oven. The course of gas production is actually the same in the vertical retort as in the Munich chamber—the heat from the walls gradually carbonizes the coal in layers; but the more uniform temperature of the chamber walls results in more uniformity, and the coke benefits thereby. A comparison of the carbonizing diagrams of Munich chambers and Dessau vertical retorts, in respect of the calorific power, illuminating power, specific gravity, composition, and quantity of gas, at different times, displays great similarity, and points to the principle on which the carbonization is effected being the same in both. The essential difference lies in the time for carbonization, which is dependent on the thickness of the layer of coal to be carbonized and on the heat of the setting.

Dr. Bueb further thinks that the Munich chamber cannot be entirely filled, and that consequently it must contain injurious free spaces. But the charging opening of the chamber is so high, and the inclination is such that complete filling of the chamber can be accomplished forthwith. On the other hand, the channel in which the gas collects to pass out of the chamber is little heated, and the high velocity of the escaping gas therein results in there being less decomposition of the gas than there is in a retort. The formation of scurf in the vertical retort is a sign that such decomposition occurs there. In the Munich chamber about half as much scurf is formed as in ordinary gas-retorts. As to temperature, it is very uniform in the Munich chambers; being, according to the description of coal in use, about 1250° to 1300° C. In vertical retorts, Dr. Bueb states that it reaches 1400° C., or even more, at the bottom. Danger from too high heat appears therefore better avoided in the Munich chamber than in the Dessau retort.

Dr. Bueb goes on to say that the twenty-four hours period of carbonization offers no special advantage, that it is inadequate for many coals, and that a considerable difference between the maximum and minimum make per hour puts considerable strain on the following apparatus, and entails it being provided of larger size. But the diagrams given last year indicated a nearly ideal uniformity of make throughout the twenty-four hours with the Munich setting. It is only in the first half-hour that there is a noticeable increase, and in the last two hours a similar decrease. But, ordinarily, the chambers would be filled in succession; and between the charging of the first and the last many hours would elapse. There would thus result uniformity in the quantity of gas produced per hour. Dr. Bueb's fear that English coals, for instance, could not be carbonized in 24 hours in the chamber, is already shown to be groundless by trials made at Munich—especially with the English coals as supplied to the Hamburg Gas-Works. The larger lumps of coal were broken to 4-inch pieces; but otherwise these English coals were charged into the chambers just as received, without any selective disposal of dust or lumps in the chamber. Yet they were completely carbonized without difficulty in 24 hours.

The objection raised by Dr. Bueb—that by exclusive day-charging the gas evolved at night would be of poor quality, and that costly arrangements would have to be made to ensure its uniform admixture with the gas made by day—has been shown by experience to be groundless. The mixing takes place in the gasholder in a very short time; and with a little care in the filling of the holders, a perfectly uniform gas is obtained for distribution. Dr. Bueb also referred to the admitted difficulty of dealing with the large quantity of coke which is discharged at once. But this difficulty is being overcome, and has indeed been met in the Hamburg installation of chambers. The block of coke falls into a chamber, with a flue, and is taken thence by conveying troughs, which at the same time quench it. A similar arrangement is being adopted for the new installation at Munich.

Dr. Bueb finally speaks of the possibility of water-gas production being excluded in the Munich chambers, owing to shallowness of the layer of coke, and the difficulty of uniform distribution of the steam through the coke. In the new chambers, however, the layer of coke has a depth of 2·8 metres (9 ft. 2 in.), which should be amply sufficient for decomposing steam. The old chambers are only 1·8 metres (nearly 6 feet) deep. But, with the chambers, if an increased volume of gas is required, a higher heat can be used, and a make of 13,350 cubic feet per ton is at once secured. This is the average result of a practical twenty-days trial, with the temperature kept within the limits of 1250° to 1350° C., even in the hottest places. There is no need to adopt the plan of introducing steam in order to diminish the formation of scurf, because, as already stated, there is very little deposition of it in the Munich chambers. It is, further, wrong to assume that water-gas production at the close of the 24 hours carbonizing period would be attended by great irregularity in the quality of the gas. The water-gas production would coincide with the evolution of rich gas from other recently charged chambers, and an equalization of the quality of the mixed gas would ensue, which would leave nothing to be desired.

As to the economy of the Munich chambers, the author has not the same abundance of data to draw upon as there is in regard to the Dessau vertical retort. The Munich installation of five settings was inspected when it had been in use for one year; and the general result of the inspection has already been given. Particulars of wages were given last year. But next year the author hopes to be in a position to give more figures derived from the new installations. The first cost of the Munich chambers, however, is admittedly high, because of their solid and massive construction. This should certainly be repaid fully by greater durability. It will always be possible, if experience justifies the change, to adopt a less massive construction, and so reduce the quantity of fire-brick, &c., used. The retort-house need be little more than a roof. The economical effect of a high cost of installation can only be judged after due regard has been paid to the maintenance charges, which naturally have been very low up to the present time at Munich. They cannot be satisfactorily computed until the installation is older. But it may be taken as correct that the durability will be very high, and the maintenance charges small even in later years.

The manual labour has been reduced to a minimum with these chamber settings; and there is no danger attendant on the charging and discharging. The men are not troubled by the heat, smoke, or coal dust. Economy of labour would be much more pronounced in larger installations, in which a special staff would be employed wholly in charging and discharging. It has been the author's aim to secure as great an independence as was possible in the working of the staff.

For many decades, gas has been made in ordinary retorts, and there has been continuous development in the old types of retort-settings right up to the present day. The new systems of settings have, also, already passed up many steps in their development, and have yet more to pass. The process of development cannot take place with any one of them wholly within the narrow compass of a single gas-works; it needs the co-operation of the industry at large. In the interests of the gas industry, the author hopes that the best results may ensue from these ever-proceeding endeavours.

According to a paragraph in the "Journal of the Society of Chemical Industry," Herr C. Bachem has found that the salts of lanthanum, yttrium, didymium, cerium, thorium, and zirconium possess a relatively low toxicity, so that chronic industrial poisoning in the course of the manufacture of incandescent gas-mantles need not be anticipated. It is stated that lanthanum sulphate and the nitrates of didymium, yttrium, and thorium, have an antiseptic action.

The Council of the Royal Society of Arts, with the approval of His Royal Highness the President, have awarded the Albert Medal of the Society for the current year to Sir James Dewar "for his investigations into the liquefaction of gases and the properties of matter at low temperatures—investigations which have resulted in the production of the lowest temperatures yet reached—the use of vacuum vessels for thermal isolation, and the application of cooled charcoal to the separation of gaseous mixtures and to the production of high vacua."

Referring to the engineering exhibits at the Franco-British Exhibition, the "Manchester Guardian" last Tuesday said: "The gas undertakings of Great Britain have united to illustrate the uses of gas, and have prepared an interesting series of exhibits in which gas is made to perform useful operations, varying from the driving of gas-engines to the heating and lighting of rooms. The co-operative basis of these exhibits is one deserving of careful consideration by business men, as it indicates a tendency likely to develop greatly at future exhibitions."

CONCRETE BUILDING FOR AN OIL-TANK.

At the last Meeting of the New England Association of Gas Engineers, Mr. C. F. Leonard, the Assistant-Superintendent of the Fall River (Mass.) Gas Company, read a paper in which he gave some particulars in regard to the construction of a building in reinforced concrete as a protection to an oil-tank. The following are some extracts from the communication.

The erection of a 150,000 gallon oil-tank, adjacent to a railroad track and in a thickly populated district, made a building around the tank necessary, both as a protection from fire and to act as a reservoir in case of leakage of oil. The reinforced concrete type having been determined upon, and bids invited, they were all believed to be too high. So the Gas Company undertook the erection of the building. About five years ago they erected a similar tank and used a brick building. This time, however, some new problems presented themselves with a concrete structure. The tank is 36 feet in diameter and 20 ft. 6 in. high over all, and is made of tank steel, weighing 10 lbs. per square foot. The flat roof is submerged 6 inches below the top edge. The roof is supported by 28 vertical posts of 3-inch wrought-iron pipe, flanged at each end. The upper flange is bolted to the submerged roof, and the lower one lag-screwed to a piece of 3-inch plank resting on the bottom. The steel angles connecting the bottom with the sides and the sides with the roof are $2\frac{1}{2}$ in. by $2\frac{1}{2}$ in. by 5-16ths in. There is a 20-inch diameter manhole in the roof and a ladder inside and outside. The vertical seams on the side are double riveted, and the rest single riveted. All the seams are caulked water-tight.

The reinforced concrete building surrounding the tank is 42 feet inside diameter, 12 inches thick, and 25 feet high above the foundation. It is surmounted by an octagonal steel roof of corrugated iron covering, with a rise of 12 feet, and a small ventilator in the apex. The wall is reinforced by $\frac{7}{8}$-inch round steel rods, 37 feet long, bent to the curvature of a centre line 10 inches from the inside face, and with laps of 33 inches. The spacing of the rods beginning at the bottom is $3\frac{1}{2}$ inches, and increases to 30 inches towards the top. Half-inch Ransome rods, 7 feet long, bent at right angles and spaced 18 inches, were set vertically and radially to bind the side walls to the foundation.

This building, making proper allowances for weight of concrete, weight of roof, and wind pressures, is perfectly stable as an ordinary structure without the reinforcing. But if the oil-tank should leak, it would be subjected to bursting stresses; and in this emergency it would become a tank. It is therefore amenable to the hoop tension formula. Tests of Portland cement concrete of $\frac{1}{2}$ to 4 mixture show a tensile strength of fully 200 lbs. per square inch. It is, however, customary to ignore the tensile strength of concrete, and depend entirely on the steel reinforcing to withstand the tensile strains.

The result of a computation based on the design of this tank building, and using the above-named formula, is given below. The spacing of the rods at the bottom of the wall is $3\frac{5}{8}$ inches. The pressure due to 15 feet of gas oil is approximately $6\frac{1}{2}$ lbs. per square inch. Substituting these values in the formula, the allowable unit stress in the rods is 11,859 lbs. The working stress of plain steel rods is 16,000 lbs. per square inch where the elastic limit is about 33,000 lbs. Assuming that the laps in the reinforcing rods have an efficiency of 75 per cent., this gives 12,000 lbs. required, which is substantially what the computation shows.

The reinforcing rods are placed near the outside of the wall because the concrete can be tamped much more thoroughly, and a dense mixture obtained on the inside, where it is needed to prevent seepage. The bars acting as hoops, the concrete outside the bars is only necessary as protection against rust and fire. If full advantage is to be taken of whatever tensile strength the concrete possesses, the reinforcing should be placed in the centre of the wall, where—evenly surrounded by concrete—the mutual support between steel and concrete in tension is more effective.

The wall of the building was made in movable cylindrical forms, 6 feet high and 8 feet long. The inner forms were struck to a circle of 42 feet diameter, and the outer ones to 44 feet diameter. The curved surfaces of the forms were made of $\frac{7}{8}$-inch spruce boards, 6 inches wide, dressed on one side and two edges, and nailed to inside and outside chords. The chords were 2-inch planks, 12 inches wide, cut out to the proper curvature—three to each form. The inside surface of the mould was a complete cylinder. For the first three shifts the forms were supported both inside and outside by false work, and braced from the ground on the outside. A $\frac{1}{2}$-inch wire rope was stretched round the tank with two turn-buckles, and the forms on the inside were braced away from the tank and drawn to it with telephone wire, passing through the forms near the top, and attached to the wire rope. Pieces of wood 12 inches long were placed at frequent intervals to separate the forms from each other; but great care was taken to remove them, as well as all wire, as the concreting proceeded. To do away with a large amount of outside false work on the fourth and fifth shifts, which were just above the oil line, the forms were supported by $\frac{1}{4}$-inch stiff wire rods threaded, running through near the bottom, fastened by nuts and resting on the concrete. The rods were left in the wall. This method of handling the mould effectually prevented bulging.

Experience indicates that a rich, dense mixture is necessary to prevent seepage. The author used a mixture of 1 of portland cement, 2 of sand, and $3\frac{1}{2}$ of broken stone (1-inch mesh) for the first 15 feet, and $\frac{1}{2}$ and 5 for the remaining 10 feet. It was hand-mixed and wheeled up an incline to a plank platform, made level with the tops of the forms, and running between them and the tank. The concrete was placed in 6-inch layers quite wet, so as to get it thoroughly round the reinforcing. A flat rammer was used, and also a wedge-shaped one, to force the stone back and leave a clean cement mortar face, without voids, on the surfaces. The bottom ring, 5 ft. 6 in. high, was all placed in one day; but after that, in order to keep the carpenters going, the forms were shifted about one-third of the circumference at a time, and the concreting followed along after in spiral fashion. The forms were scraped and greased before being used again. When necessary to stop at a vertical joint, a 2 in. by 3 in. planed stud was placed, so as to make a tongue and groove for a bond when the ring was continued. The horizontal joints were broken the same way; care being taken to remove these wooden pieces before the concrete set hard. The sills and lintels of the two doors and eight windows at the top of the building were cast in moulds on the ground, and afterwards placed in position. They were reinforced the same as a concrete beam, fixed at the ends, with Ransome bars, projecting about 6 inches from the ends to tie into the wall. When finished, the wall was painted inside and outside with two coats of neat portland cement.

The cost of the walls per cubic yard of concrete was as follows: Cement, $2·81; sand 66 c.; crushed stone, $1·42; common labour, $4·25; steel reinforcement, $1·65; lumber, nails, and miscellaneous supplies, $1·46; carpenters' labour, $5·25—total, $17·50. The cost of carpenters' work was fully twice what it should have been, owing to local labour conditions. The total cost of the walls was $2170, compared with $2820 for the brick tank building. The net saving, therefore, resulting from the use of reinforced concrete was $650. The cost was only 77 per cent. that of the structure put up in 1902; and the author expressed the opinion that, if the labour conditions had been more favourable, fully $300 more could have been saved.

A Tribute to Good Management at Ossett.

It is so seldom that the Chairman of a Gas Committee, when presenting the minutes containing the annual report of the Manager, has to acknowledge that, though they contain several things of considerable interest, these are entirely overshadowed by the report, that the proceedings at a recent meeting of the Ossett Corporation, reported elsewhere, call for notice. The gas undertaking has had another successful year, attributable in the first place and in a large measure, as was frankly admitted by the Chairman of the Gas Committee (Mr. H. Robinson), to the "growing ability, increased interest, and enthusiasm" of the Manager (Mr. A. E. Mottram), who has the supervision of all the technical details. But another factor, and an important one, contributing to this success is the attitude of the Gas Committee, who direct their attention principally to the financial side of the concern; and while, as a rule, they keep a tight hold on the purse-strings, they are not so short-sighted as to do so when they are advised that relaxing them will be for the ultimate benefit of the undertaking. Then at Ossett the Committee and their Manager have the loyal support of the public, without which even good management could not make the business of gas supply the success it is in the town. The inhabitants generally appreciate the value of gas, while the users of power bear willing testimony to its ease of manipulation and low cost. Unfortunately, the "gilt edge" of this success, as Mr. Robinson said, was taken off by the necessity for increasing the charge for gas owing to the advance in the price of coal; and another disappointing circumstance to some was that there was nothing to hand over in relief of the rates. However, the "record" profit of £8136 made last year is satisfactorily accounted for. No less than £6637 of it was required for interest and redemption of loans—for satisfying what Mr. Robinson called a "monster with a voracious appetite;" and £1360 was used to clear off the retort suspense account. In fact, the Committee have been spending freely on improving the works and plant since they came into their possession; and the result is shown in greater earning capacity and reduced leakage. Having reached the present stage of efficiency, one member of the Council seemed to think it is time for the Committee to cry "Halt," and devote some of the future profits to reducing the rates or helping to pay for the new Town Hall. But another member very properly pointed out that in a gas undertaking there is no such thing as standing still. The Committee must go forward and keep abreast of the times, or they would certainly retard. This fact cannot be too strongly emphasized. Should there be a disposable balance in the future, it might be usefully employed in reducing the price of gas, so as to induce present consumers, of whom there is one in every house, to use it more freely; for it seems that it is in this direction, rather than to additional numbers, that the Committee will have to look for an augmentation of their output.

Coal tar dyes (alizarine as well as aniline) are, according to His Majesty's Consul at Constantinople, being found unsatisfactory as regards durability; and Turkish dyers are reverting to the use of the old natural dyes. The importation of cochineal, for instance, is said to be increasing again—60 tons annually being now imported into Constantinople alone.

HISTORY OF PHOTOMETRIC STANDARDS.

By F. N. Morton.

[A Paper read before the Philadelphia Section of the Illuminating Engineering Society, U.S.A.]

We have already passed the second centennial in the history of photometry. In 1700, Francois Marie estimated the intensity of light by placing pieces of glass behind each other, and then counting the number required to produce total obscuration. The first mention of what we would call a standard, however, was by Bouguer, who, 60 years later, said that the simplest way of specifying the intensity of light was to find out the number of candles necessary to give the same light; but he did not specify any particular candle. In the year 1800, the carcel lamp, the present French standard, was brought out; and from about 1850 to the present time many different plans were tried, found wanting, and (mostly) abandoned. Although some of the brightest minds in the scientific world have been working on the subject, we must admit that we have not as yet anything which can be called an absolute standard. The candle, which is as near an absolute standard as we have, gives concordant results only through averaging a large number of observations. For scientific work, this is too much like the old English law defining the method of obtaining a legal measure of length, which was to take the first score of men coming out of church, make them stand toe of one to heel of the next in front, and take one-twentieth of the distance from the heel of the last to the toe of the first and call it a foot. There is a ludicrous resemblance which will appeal to those who have had to use candles extensively.

Candles.

Tallow.—Murdoch seems to have been the first to discover that there was any difference in candles; for, in 1808, he specified tallow candles weighing six to the pound and burning at the rate of 175 grains per hour. A few years later, Lord Stanhope proposed that the wicks should be waxed before being coated with tallow.

Wax.—The wax candle was used by Ritchie in 1824, and was recommended by Alfred King, the Engineer to the Liverpool Gas Company. In 1849, it was made a legal standard by Parliament, which, in that year, included in the Great Central Gas Company's Act—in pursuance of the recommendations of Dr. Leeson and Mr. Cooper—a clause providing that the illuminating power of the gas supplied by that Company was to be not less than the light produced by 12 wax candles, six to the pound, each consuming 120 grains of wax per hour. Dr. Letheby, whose duty it was, as Chemist to the City of London, to test the quality of the gas, reported that the candles burned irregularly; could not snuff themselves; and that there was difficulty in knowing when they were burning properly. These candles were superseded by the sperm candles in England in 1860 by Act of Parliament.

Stearine.—There are two forms of stearine candle, one the French "Bougie de l'Etoile," or star candle, and the other the Munich candle. The former, which attained but limited employment, and which went out of use in 1860, was tested by Peclet in 1830, and found to give a light equal to 0·143 carcel. Later tests by Monnier gave 0·136 carcel when five candles came in a package, and 0·131 and 0·132 carcel with a 10 grammes per hour consumption and a flame height of 52·2 mm. respectively, with six candles to the package. According to Monnier, the candle required not only a consumption of 10 grammes per hour, but a flame height of 52·4 mm. The London "Journal of Gas Lighting" in 1859, speaking editorially of this standard, said: "For uniformity and steadiness of light, the stearine candle sold in France under the name of 'Bougie de l'Etoile' far surpasses the ordinary sperm candle." At Melun, the street lighting contract called for a certain illuminating power of the gas in terms of this unit. The municipal tester, to avoid the fluctuations of the candles, applied to the Mayor for permission to use the carcel lamp. In testing to determine the ratio, he found it to be 0·131. The Munich candle conforms to the type of candle specified in the contract between the city and the Gas Company, and outside of that place was never used as far as I am able to learn.

Paraffin.—The use of wax candles was urged by Lewis Thompson in a letter to the London "Journal of Gas Lighting," published in the number for Oct. 11, 1852. In this letter he says that paraffin is superior to spermaceti and wax, and announces that Messrs. Field are about to commence the manufacture of paraffin candles possessing a photometrical value equal to 120 grains per hour of the best sperm. He also adds that paraffin has the advantage of being easily tested as to purity, and its composition is easily fixed and determined all the world over; while that of sperm varies with the age and health of the animal, and according to whether it comes from the head or body. There is no record at hand, however, to show that paraffin candles were used to any extent in England.

In Germany, however, the paraffin candle was a recognized standard—being adopted in 1872 upon the recommendation of the German Gas Association. The candle had a uniform diameter of 20 mm. and weighed one-twelfth of a kilogramme. The wick was composed of 24 cotton threads, one of which was to be red as a distinguishing mark, and was to weigh, dry, 0·668 gramme to the metre. The paraffin of which it was made solidified at 55° C.

In the earliest recommendations it was directed that the candle be allowed to burn freely; and when the flame had reached the height of 50 mm., observations were to be taken. Later, however, the recommendation was made that the wick be snuffed, to insure reaching the standard height more quickly.

Lummer and Brodhun found great difficulty in seeing the exact termination of the base of the flame, and were troubled by the top of the flame splitting into three parts, and also by the flame smoking when it was near the normal height. Their measurements show, moreover, that the relation between the flame height and the intensity is not a fixed one, because, at one time, when the flame remained at 50 mm. for some minutes, the readings ran from 0·412 to 0·430.

Sperm.—This is the immediate successor in England of the wax candle. It was first used by the Great Central Gas Company in 1852 as a substitute for wax. Two were used instead of one as formerly; and later a long candle was employed, cut in two, and each half burned from the middle to the end. Its general substitution for wax was agitated in 1856, but was not legalized until the Metropolis Gas Act was passed in 1860, which contained a clause specifying the illuminating value of the gas in "sperm candles of six to the pound, each burning 120 grains per hour." Here a wail arose from the gas companies, as the sperm candles gave more light than the old wax in the proportion of 12 to 9½, or of 16 to 14, according to the various authorities.

It was soon found that the sperm candles were very much open to objection, and they hardly came into use before they were made the subject of attack. In 1864, Drs. Letheby and Odling reported wide variations; and similar statements came from Kirkham and Sugg, and others. Captain Webber and Mr. Rowden, at the Paris Exposition of 1867, said that the light emitted was very irregular, even with a uniform consumption. It was affected by draughts; and by manipulating the wick a variation of 10 per cent. in the illuminating power might be obtained, even after correcting for variation in the consumption. Even if one experimenter got constant results, his values would not be those of another. Moreover, the intensity was too small, because, for accuracy in reading, the lights to be compared should be as nearly equal as possible. Henry Gore also found a variation of 10 per cent. in candles.

It is needless to quote more opinions in regard to the eccentricities of candles. Every effort was made by the authorities to obtain one that would be reliable; and specifications were extended and multiplied, and rules for manufacture were made more definite. But a satisfactory product was not forthcoming. There is a possibility, however, that the fault lies with the makers to a greater or less extent. It is axiomatic that any standard must be made strictly according to the established rule. At present the specifications are most exact. Dr. E. G. Love, the City Gas Examiner of New York, in a spirit of investigation most reprehensible from the manufacturers' view, compared the standard candles received by him with the specifications. This is what he found—

The specifications called for a wick composed of three strands each of 18 threads. There were three strands; but the number of threads varied all the way from 18 to 24. There should be from 32 to 34 plaits in 4 inches of wick when extended by a pull just enough to straighten it out. The plaits really ran from 27 to 35. The wick, after steeping and drying, should weigh not less than 6 nor more than 6½ grains for each 12 inches. The weight ran from 6·68 to 8·84 grains. The weight of the ash from 10 wicks after treatment with water should be 0·025 grain. It ran from 0·041 to 0·103 grain. The spermaceti should have a melting point of from 112° to 115° Fahr., and that of the finished material in the candle would be slightly raised by the from 3 to 4·5 per cent. of beeswax added to prevent crystallization. Instead of this, the melting point was actually between 108·7° and 111·5°. If a 40-grain brass weight is attached to the wick and the candle floated in water at 60° Fahr. taper end down, it should float with a 2-grain weight placed on top, and sink with a 4-grain weight. And as a matter of fact, some candles sunk without any weight at all, and others did not sink until 12 grains were added.

Not a single requirement was complied with. The candles could not be expected to give uniform results under the circumstances. Mr. Walter Grafton made a very exhaustive set of experiments on the reliability of candles, and laid special emphasis on the necessity of adhering strictly to specifications. His paper, which is really a defence of candles, said that the Referees' "Instructions" should include a diagram of the candle, showing the exact curvature the wick should assume while burning, as this has a marked effect upon the light emitted. As a result of care in manipulation, the average error over the series was 0·002 per cent.

I am not defending the candle. I have passed too many hours with it, and been too closely associated with it, ever to want to see another. It has been painted in pretty black colours, however; and I believe that it is only fair to give to it whatever commendation there is, for that is little enough.

Carcel Lamp.

This is the oldest photometrical standard in use to-day, and was invented by Carcel about 1798 or 1800. It consists of an argand burner with a wick and chimney; the oil for consumption being forced by pumps through the central pipe to the burner above. These pumps are operated by clockwork contained in the base. There are three of these pumps emptying into a common space. An overflow of the surplus oil is always maintained, so that the wick draws its supply from a constant head, insuring uniform conditions. Colza, or rape-seed, oil is used.

Dumas and Regnault, who made exhaustive tests of the lamp, found that with a consumption of 42 grammes of oil an hour, there was least variation in illuminating power for a given variation in the oil consumed. The lamp is, therefore, operated to burn that amount of oil, regardless of the height of the flame.

The wick seems to be the delicate part of the lamp. The rules for the official testing of the gas of the City of Paris, and which were drawn up by Dumas and Regnault, direct that a new wick be used for each test. The wicks should be stored in a dry place, and preferably in the presence of an absorbent of moisture.

In regard to the value of the lamp as a standard, authorities differ. Dumas and Regnault found it satisfactory; while Crova says:

> I do not hesitate to affirm that the French standard is, if not free from all reproach, at least one of the best known; but it must be remembered that photometric determinations are very delicate, and demand a very careful observer. The illustrious Fresnel would not allow anyone else to prepare his carcel lamp for him. He regulated it, and he himself cut the wick with the greatest care. Under these conditions, it is possible to reach an approximation of 1 in 60, or we may reach that of 1 in 100.

He also says that it is true that others, unquestionably expert in photometry, have, through failure to conform rigorously to the rules, found the lamp defective.

Captain Webber and Mr. Rowden, at the Paris Exhibition in 1867, reported favourably on the lamp, saying that it was but little affected by draughts; that the wick, being entirely below the flame, could not influence the light; and that both the wick and oil were readily tested by the operator. Inasmuch as the wick is actually consumed to such an extent that it is necessary to use a fresh one for each test, there seems to be somewhat of a discrepancy here. On the other hand, Hartley said that this was a worse standard than the candle; the Dutch Gas Association reported variations in comparative tests as high as 3·89 per cent., and said that it was so inferior that it could not be adopted as a standard; while the Electrical Congress in Paris, in 1881, declared against it.

Peclet, who was one of the first to take up the carcel as a standard, found a steady increase in illuminating value through four hours of constant burning, amounting at the end of the period, to 17 per cent. After this, it remained constant for three hours. Émile Durand says that the lamp should always be tested with a stearine candle before using. Dibdin, in 1888, found a mean deviation of 1·34 per cent.; the maximum being 4·1 per cent. In spite of the objections to this lamp, it has remained the accepted standard in France, and is the official standard for testing the gas in Paris.

The Keates Sperm-Oil Standard.

Keates, Consulting Chemist for the City of London, objected to the carcel lamp because the chimney had no fixed position, and a slight difference in placing it affected greatly the light emitted. He also criticized the method of supplying oil to the wick. In 1869, therefore, he brought out a modification of the carcel lamp in which the height of the chimney is fixed, and in which the oil difficulty was overcome by making a row of holes ½ inch below the upper edge of the wick-holder, so that the oil was raised a constant distance by capillarity. The lamp was also modified by having a metallic cone to direct the air against the wick—thus insuring steadiness of flame. It was used in a balance, like candles and the carcel.

Keates said that a worse material than colza oil could not have been proposed. He, therefore, used sperm. The lamp, in its early form, gave 10 candles, but later was made to give 16 candles.

In 1881, Dibdin tested the lamp over a period of six weeks, and reported that 71 per cent. of his observations fell within 1 per cent. of the mean, and all within half-a-candle. The Board of Trade "Committee on Photometric Standards" gave it a high rating for steadiness during tests, but rejected it as a standard because of sudden variation in intensity due to failure of the wick.

In 1887, however, Dibdin made another report, in which he said that the lamp could not be relighted without adjustment or renewal of the wick, introducing discrepancies; and, furthermore, various operators found it difficult to obtain flames of uniform character. He said: "The lamp has failed in practice . . . not so much from any inherent defect as from the severe trial it makes . . . upon the patience of the observer." This standard has never passed the laboratory stage.

Violle's Melted Platinum.

At the Paris Exhibition in 1881, Violle proposed as a standard the radiations of a square centimetre of melted platinum. He then undertook a series of experiments on silver. By means of a thermopile, he measured the radiations through a quartz diaphragm carried in a hollow, water-cooled screen, and found that from the time the edges began to harden, the radiation was very constant. When the centre of the pool began to harden, there was a slight increase, followed by a decrease as the metal solidified. In actual practice, the time of taking the observation is the moment of solidification of the platinum. This is indicated very exactly by a characteristic flash which is produced regularly and surely when a mass of platinum of not less than one kilo. is used. One reading having been made, it is necessary to fuse the platinum again for a new observation. It is said that it is necessary to have the platinum absolutely pure, as any foreign material will not only change the melting point, but will cause a scum on the surface of the metal.

Aside from the practical difficulty of using such a standard in everyday work, there seems to have been as much squabbling over this standard as over any other. The system was recommended by a Congress of Electricians held in Paris, and rejected in 1881 by another; while the British Association "Committee on Standards of Light" in 1888 stated that it was not a practical standard. Dr. Lummer says that where the platinum is melted by a blow-pipe flame, it must be rejected as a standard of light, and when by an electric current, there are variations of from 10 to 12 per cent. Von Hefner-Alteneck pointed out that the temperature of solidification is not a definite point for any liquid, and that the light alters greatly with slight changes of temperature.

In use, the platinum, in quantity of not less than one kilo., is put into a lime crucible and brought under the oxy-hydrogen furnace. When it is melted, it is run under the perforated, water-cooled, diaphragm by a crank connected with a rack-and-pinion. The light passing through the aperture is reflected by a mirror to the photometer disc.

This still seems to be accepted as a standard, although its use must of necessity be very limited.

The Siemens Platinum Standards.

To avoid the error in the Violle standard due to variation in the fusion temperature, Siemens proposed to use platinum foil at the melting point. He employed a narrow strip of platinum foil, and heated it to fusion by an electric current—keeping the photometer disc in balance as this point was approached until the light failed. The last setting was taken as the basis for calculating the intensity of the light.

The usual disagreements arose over this standard. Liebenthal obtained very good results with it—finding an average deviation between it and the amyl-acetate lamp to be about 2·9 per cent.; while other experiments gave 0·9 per cent. mean deviation. Liebenthal says these differences do not result from variations in the molecular structure in the platinum, but from the difference in colour; the platinum giving a much whiter light than the other. Lummer and Kurlbaum, on the other hand, found by hundreds of experiments a deviation of 10 per cent. or more from the normal. It must be, nevertheless, remembered that, however accurate this standard may be, it has the serious defects of necessitating catching the observations "on the fly," and of admitting only one reading at a time.

Reichsanstalt Hot Platinum.

The Reichsanstalt suggested using as a standard one square cm. of a strip of platinum heated by an electric current to a temperature defined by the ratio between the total radiation and that through a layer of water 2 cm. through, enclosed in a quartz vessel with parallel sides 1 mm. thick. The relative radiations were measured by a bolometer. The strip of platinum is surrounded by a circulating water-jacket. The surface of the platinum, which volatilizes in use, becomes as smooth as a mirror, and gives, according to the tests, errors not to exceed 0·5 per cent.

A modification of this method was proposed by J. E. Petavel. He found that radiation through black fluorspar varied inversely as the temperature; while all other substances experimented upon varied directly. The curves of temperature and radiation of black fluorspar and some other substance (glass being selected) must cross at some given point, which was to be the temperature at which to maintain the platinum. The standard, therefore, consisted of a strip of platinum raised to incandescence by an electric current. The platinum strip was placed behind a water-cooled screen containing three openings—the central one pointing to the photometer, and each of the other two towards a thermopile connected in opposition to a galvanometer; screens of glass and black fluorspar of given thickness being interposed respectively. If the radiations are equal, the galvanometer will stand at zero, and the platinum must be at the standard temperature.

Petavel came to the conclusion that only three substances are valuable as radiators: Platinum, platinum-iridium (25 per cent. iridium), and iridium.

I have no record of either of these standards appearing outside the laboratory in which they had their birth.

Crova's Melted Zinc.

As a modification of the melted platinum standard, in 1880 Crova suggested using as a standard the light given out by 1 sq. cm. of the black surface of an iron vessel in which zinc was boiling. Here the constancy of temperature may be maintained; but nothing seems to have come of the suggestion.

Electric Arc.

In 1892, the adoption of a portion of the electric arc was independently suggested by James Swinburne and Dr. Silvanus P. Thompson. It is stated that if the carbon forming the arc is pure the light of the crater surface is uniform, except at the edges, which are duller. The temperature, which is as definite as that of boiling water, is taken by Dr. Thompson as 3500° C., and increase of current or voltage or change in the length of the arc has no effect on either the temperature or the light emission. Dr. Thompson found, however, that an error might be introduced by the thickness of the diaphragm and its obliquity; and he also found that natural graphites always give less light than artificially

prepared carbon. The illuminating power of 1 sq. cm. of hard carbon has been found by Trotter to be somewhat less than 70 candles.

Violle believed that the electric arc formed the seat of a perfectly defined physical phenomenon; the boiling point of carbon being constant. Trotter, who attempted to use it for a standard, found that the effective luminosity is neither constant nor uniform; and the use of rotating sectors showed that the bright spot in the crater seemed to be always revolving. All attempts to prevent this phenomenon, such as enclosing the arc in a small chamber of transparent mica, the use of magnets, and an air blast, were without effect.

Another attempt to use the electric arc was made by Blondel, who gave to the crater surface an obliquity of from 40° to 60° from the vertical by inclining the carbons. He used a water-cooled screen pierced with openings of different sizes, any one of which might be brought before the arc by rotating. To make sure that the light was coming from the region of maximum brightness, a small lens was dropped temporarily in front of the opening, and an image of the carbon points was projected upon a screen placed at right angles to the photometer bar. Blondel has determined the intrinsic brightness from this source to be 158 candles; the extremes being 150 and 163.

It is of paramount importance for the carbons to be of pure graphite, as any impurity alters very materially the light emission.

(*To be continued.*)

ELECTRICITY CHARGES IN BOSTON (MASS.).

Uniform v. Maximum Demand System.

[COMMUNICATED.]

AFTER an investigation lasting over a year, the Massachusetts Gas and Electric Light Commissioners have, on the petition of the Public Franchise League of Boston, recommended that the Edison Electric Illuminating Company of that city—the largest electricity supply undertaking in the States—shall, on and after the 1st prox., offer to sell electricity for any purpose at a uniform price not to exceed 12 c. per kilowatt-hour. At present the Wright maximum demand system, in modified form, is used by the Company; and the Commissioners criticize it as complicated, and as failing to meet the ideal that the Company seek to attain in attempting to charge each customer in proportion to the cost of supplying him. The decision represents so much study of a problem of great importance to the central station industry in all countries, that it has been thought worth presenting, in part, to readers of the "JOURNAL."

The chief question before the Board was whether a differential system of rates such as the Company had adopted was unlawful because it was discriminating. The essential feature of the Company's system of rates is that, instead of basing the price altogether upon consumption, irrespective of demand, as is done with a uniform or "flat" meter rate, they base it both upon the demand and the consumption. Any system of rates founded on the demand system is based primarily upon two factors—viz., the length of time a given demand runs, and the size of the individual demands. The combination of the two factors necessarily leads to different average rates for the customers, and even from month to month for the same consumer. The Board stated that the justification of any system of individual rates must rest upon the practicability of ascertaining, with reasonable accuracy, the cost of supplying each individual consumer, and of automatically apportioning this cost to him by the schedule of prices adopted. It was thus essential for the Company to be able to demonstrate that it was possible to ascertain individual costs with reasonable accuracy, since under their system of charging a customer should not pay less than the cost of his supply, and properly (and probably legally) could not be required to pay more.

In attempting to make this demonstration, the Company started with certain factors which were capable of being ascertained definitely for any period in the history of the business. These were the maximum station demand, the amount per kilowatt of station demand required to cover the expenses allotted to fixed costs, the number of kilowatt-hours sold, and the amount per kilowatt-hour sold required to cover the expenses allotted to running cost. The Company also knew the maximum demands of all the customers upon whose premises demand meters were located, and could fairly estimate the demands of other customers. The Company seemed to assume as their essential premise in their demonstration that the ratio of a customer's maximum demand to the aggregate maximum demands of all the customers (other conditions being equal) represented with reasonable accuracy his proportional share of the Company's investment, and therefore of the so-called fixed costs. But apart from the practical difficulty of ascertaining this ratio, it is at once conceded that the ratio would not in itself definitely determine his proportion, because actual conditions require the recognition of the so-called "diversity factors"—*i.e.*, the ratio of the sum of the customers' demands to the actual station demand. In fact, in the year ending June 30, 1907, the maximum station load was 35,310 kilowatts, against upwards of 48,000 kilowatts, the aggregate of the customers' maximum demands, as nearly as they could be estimated. While the evidence tended to show some recent efforts to test the accuracy of the diversity factors, it also tended to show that the residence lighting, for example, might have a far more favourable diversity factor than the one assumed in making the present lighting rates; and this is probably due to the fact that, unlike business lighting, the maximum demands of residence customers are not so nearly coincident. The maximum demand of a residence consumer often represents his exceptional, and not his normal, use of electricity.

The importance and significance of these diversity factors must not be under-estimated. The purpose of their introduction is to so correct the relation of an individual consumer's maximum demand to the maximum demands of all the customers that his responsibility for the station peak, and therefore for the Company's investment, shall be properly ascertained and apportioned. However determined and applied, they ascertain and apportion not the actual cost of supplying an individual consumer, taking into account the conditions peculiar to his supply, but rather the supposed cost of supplying him, assuming that his supply is based on certain average conditions. It is equally evident that the investment for which the consumer is claimed to be responsible is not an amount definitely ascertainable once for all, but one dependent upon a standard—viz., his maximum demand—which may vary widely from time to time without any actual influence upon the Company's investment. Confronted with the impossibility of determining actual individual distribution investment costs, it might be expected that the Company should apportion to the individual distribution as well as generating cost on the basis of maximum demand, on the ground that the lamps and copper conductors are a considerable part of the distribution investment needed, and are proportional to demand. But, instead of doing so, the Company departed from their first theory by introducing an assumption—viz., that, on an average, it costs far more per kilowatt of demand to reach and supply the small consumer than the large one, and on this based their justification for their wholesale discounts on account of quantity, irrespective of length of use. In other words, it is again made evident that the Company are not ascertaining individual costs, but are substituting results obtained from applying the almost universal rule of averages by means of a system of arbitrary and sometimes inconsistent factors.

According to the Commissioners, to charge A one price and B another, or to refuse B the same service under like conditions, is a neglect of duty. A kilowatt-hour will do exactly the same work for one man as for another. The Company's duty, in their opinion, is to supply all with electricity; and they must treat all alike. If all the customers of a company were dependent upon it for supply, the Board feel that there would be little occasion to discuss or attempt to justify differential rates, and that a uniform meter rate, determined by reasonable operating costs and a fair return upon the investment necessary for public convenience, would prevail universally. It may be conceded that if such a uniform rate prevailed, there would be some unprofitable customers. But it is probable such a condition would not result in a greater amount of injustice than the attempt to make every customer theoretically, if not actually, profitable. The Board think there can be no more desirable requisite for every public service charge than that it should be simple, definite, and readily understood and applied. Even the most ardent advocates of the demand system do not claim that these characteristics are inherent in it.

The Board are of opinion that the present system of rates has operated to select as customers those whom the Company deemed desirable, and has tended to discourage small users of electricity. The only means by which the average lighting customer can hope to see the price reduced to him materially is through a greater increase in the volume of business relative to the Company's investment. Long use of a customer's installation, especially during parts of the year when the considerable portion of the plant is standing idle, even at very low rates, provided they exceed proper running costs, may yield a revenue otherwise not available, which will materially help to dilute the general expenses, and should lead, as the business develops, to the steady reduction of price to the regular consumer. On account of the isolated plant, the prices which are determined for a company are largely the product of individual conditions. The Board are of opinion that no differential system of rates for a public utility can be equitably and properly based solely upon the cost of supplying the individual consumer.

American Practice in Gas Piping and Lighting in Buildings.—We have received from Messrs. E. & F. N. Spon, Limited, a work by Mr. W. Paul Gerhard dealing with the above subject. The author states in his preface that in preparing the book his object was not to treat of the various processes connected with the manufacture and distribution of illuminating gas, nor to discuss public lighting, but to furnish information for the enlightenment of the gas consumer and the householder. He thought, however, the book would also be found useful by engineers, architects, builders, and building superintendents, to enable them to acquire a better knowledge as to how to introduce, distribute, and utilize gas in buildings; and that it would likewise be of value and interest to gas companies and their distribution superintendents. An opportunity will be taken to notice the book at greater length in a subsequent issue. Meanwhile, it may be mentioned that the subject-matter is contained in twenty-six chapters, occupying 278 pages (9 in. by 6 in.); and it is followed by a useful bibliography. The price of the book, which is issued by the M'Graw Publishing Company, of New York, is 12s. 6d. net.

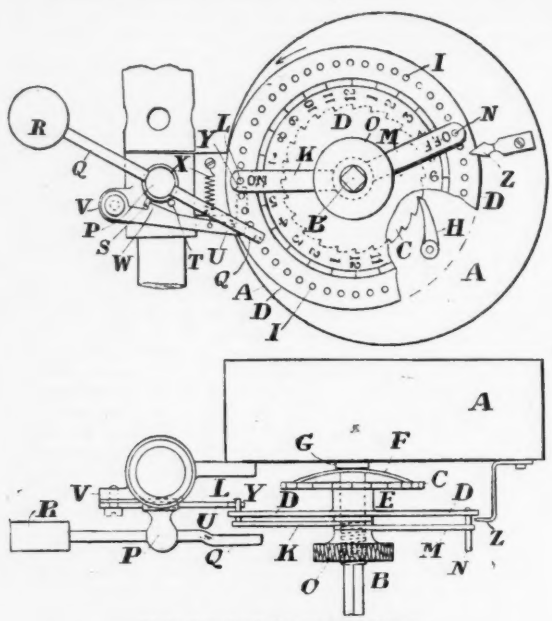
REGISTER OF PATENTS.

Opening and Closing Gas Valves or Cocks.

DIX, C., of Slough.

No. 18,555; Aug. 16, 1907.

This invention relates to apparatus for automatically opening and closing gas valves or cocks at a predetermined time through the medium of chronometric mechanism driven by an ordinary clock or time train.



Dix's Gas-Cock Opener and Closer.

The tap or cock of an ordinary gas-burner is shown attached to a barrel, drum, or casing A, which contains a time-train; the chronometric mechanism being mounted upon the winding arbor B. The ratchet wheel C is fixed to the time disc D through the collar or distance piece E; such wheel and disc being mounted and loosely journalled upon the arbor. A clock-work friction spring F is mounted upon the arbor, and is so disposed as to bear against a collar G fixed upon it, and also to bear against the rear surface of the ratchet wheel C. A pawl H, so disposed as to engage the teeth of the ratchet wheel C, is provided for preventing the time disc from being turned in the wrong direction during the operation of setting the timing mechanism, and also in the winding of the time train. The time disc may be marked with divisions corresponding with the rate of speed at which the arbor is rotated by the clock train—in this instance the arbor makes one revolution in 24 hours. The time disc is pierced with setting holes I corresponding with the time divisions, and representing intervals of 30 minutes.

Setting arms are pivotally marked upon the arbor. The setting arm K, for opening the cock (marked "on"), is provided with the setting pin L, which in its operative position passes through the rear face of the time disc and performs also the function of an actuating pin. The setting arm M, for closing the cock (marked "off"), is provided with the setting pin N, extending through both sides of its setting arm. The rear extremity of the pin N in its operative position enters one of the setting holes I; its front extremity performing the function of an actuating pin. The arbor B is screwed or threaded for the reception of the clamping nut O, securing the arms in position after they have been set, and compressing the friction spring to clamp the chronometric mechanism friction tight upon the arbor at the required position.

The cock plug P is provided with the operating lever Q, one end of which is furnished with a weight R. The operating lever is so disposed in relation to the bore of the plug that at such times as it is under the unimpeded influence of its weight the cock is open. The plug is provided with the projection S, and a stop T is fixed upon the body of the cock in such a position as to be engaged by the projection S when the plug has been fully opened by the action of the weight, and thus arrest its action. The releasing lever U is pivoted to the body of the cock or to a projection or lug V fixed to it. It is furnished with the catch-plate W, for engaging with the plug projection S when the plug is fully closed, and for locking the plug in this position. The spring X has a constant tendency to pull the releasing lever in the direction of the plug. The releasing lever has an operating projection Y, for engagement with the pin L. The dial pointer Z is fixed on the casing A, the point of it extending partly over the edge of the time disc D, so that the time of day or night is indicated, and may be read as an ordinary clock.

The time indicated by the dial pointer is 5.15, and the cock plug is at the closed position. Assuming that it is desired to turn on the gas at 6 o'clock and turn it off at 4.30, the clamping nut O is first slacked-off sufficiently for the pins L and N to be disengaged from the setting holes at that time in engagement with. The "on" setting arm K is placed in position so that the pin L enters and passes through the setting hole which corresponds with 6 o'clock on the dial; and the "off" setting arm M is then placed in position so that the pin N engages the setting hole which corresponds with 4.30. The clamping nut is now screwed up so as to clamp the setting arms in their desired positions, as shown—the disc being set to the correct time, as indicated by the dial pointer.

The action is as follows: Shortly before 6 o'clock the pin L engages the operating projection Y, and causes the releasing lever to turn against the tension of the spring X until the catch-plate W disengages from the plug projection S (such disengagement taking place as the dial reads 6 o'clock), leaving the plug under the unimpeded influence of the weight R, which weight now falls and instantaneously opens the cock to the full extent—the projection S coming to rest in contact with the stop T. The operative end of the operating lever Q is now in the upward position, and so remains until it is engaged by the pin N on the approach of the time for closing the clock, and is thereby forced downwards, lifting the weight at the opposite end until the plug projection S trips the catch-plate W, thereby again locking the plug in the closed position.

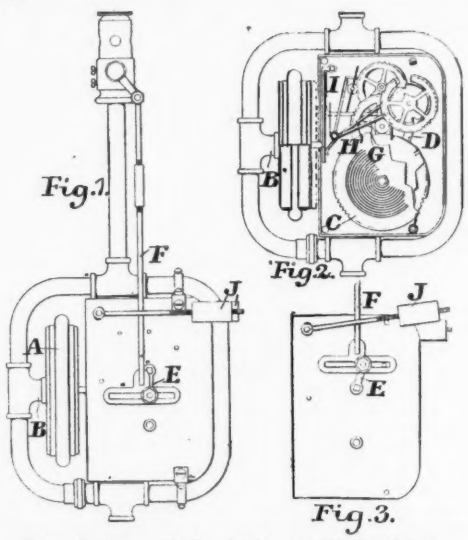
The cock may be opened at any time by simply depressing the releasing lever U so that the catch-plate W disengages from the plug projection S; or the cock may be closed by raising the weight R—in either case independently of the chronometric mechanism.

Automatically Turning On and Off Gas-Burners from a Distance.

ROBSON, G., of St. Kilda, Victoria, Australia.

No. 20,109; Sept. 9, 1907.

This invention relates to automatic means for enabling one or a number of gas-lights to be turned on or off from a single point by a temporary abnormal pressure in the gas-main acting upon an expanding body so that a train of clockwork is released and controls a valve regulating the quantity of gas admitted to the burner. It is particularly adapted for use with incandescent gas-burners with pilot lights, and allows the turning-off of the gas in the morning to be performed at a lower pressure than is required for the turning on of the gas in the evening. Other objects are to prevent the fluctuation of the pressure, by consumption or other causes, from operating the apparatus when not required; and to so make the apparatus that it may be adjusted to suit varying pressures of gas.



Robson's Automatic Gas Lighter and Extinguisher.

Fig. 1 is an elevation, and fig. 2 an elevation partly in section showing the expanding member or body and the clockwork mechanism with one side of the frame removed. Fig. 3 is an elevation of the clockwork mechanism and connections.

The clockwork mechanism (contained in a frame) is such "class of wheel mechanism as is usually applied to chronological instruments"—similar in construction to the striking mechanism of an ordinary clock. It is mounted on the pipe leading to the gas-burner. An expanding member or body A is provided—consisting of a stationary member connected to the branch B and a moving member—the two members being hermetically joined by an air-tight leather ring.

The wheel C which the spring operates drives a second wheel D, having a projecting spindle provided with a crank E, which slides in a link secured to the rod F for operating the cock of the burner. The mechanism contains two governing wheels, a fly, and a trigger having a spindle mounted in the frame of the clockwork. The trigger is provided with a number of arms. One arm, G, is designed to drop into slots formed in the periphery of a disc turning on the main wheel axle; another arm H operates on a disc with slots secured on the spindle of the governing wheel. Another arm I engages pins secured on the governing wheel, stopping the mechanism when the first arm G drops into one of the peripheral slots.

The member A is so adjustably weighted by the weights J that at the ordinary gas pressure it will not be expanded sufficiently to operate the trigger plate before mentioned, but will be made to so operate by raising the pressure of the gas to the predetermined extent. The raising of the pressure of the gas will be performed at the station from which it is desired to operate by any known means—preferably by arranging the member A to work in a horizontal direction. The member itself will thus not be weighted, but will be kept in an unexpanded condition by the action of the trigger plate; the latter having two adjustably weighted levers arranged on its spindle. One lever is secured on the spindle and the other is loose, with a boss, the projecting portions of which on each side of the recess engage with a pin on the trigger

plate spindle. A spring is provided surrounding the trigger; one end being attached to the frame, and the other end to one of the trigger arms. This tends to bring the various trigger arms into, and retain them in engagement with, their respective slots and pins. When the rod F is being raised by the crank E, a pin on the rod will raise the loose weighted lever and take part of the weight off the trigger plate, and, consequently, off the expanding member A and allow a less pressure to expand the latter.

This provides self-regulation to the extent of allowing the turning off of the gas in the morning to be performed at a lower pressure than is required for the turning-on of the gas in the evening. Another object is to prevent the fluctuation of the pressure, by consumption or other causes, from operating the apparatus when not required.

It is obvious that the weights on the weighted levers will be adjusted to suit varying pressures of gas. For instance, if the day pressure were 30-10ths, the evening pressure 35-10ths, and the early morning pressure (say from twelve o'clock midnight till dawn) 15-10ths, the weights on the levers would be adjusted so that the combined weights would give a pressure on A equal to about 40-10ths, and the loose weighted lever a pressure of (say) about 20-10ths.

Assuming that the evening pressure is about to be put on, and it is desired to light up. The present pressure being 30-10ths, the pressure is raised until it overcomes the pressure due to the weights of the member A (40-10ths as before mentioned). The member A will be expanded; the trigger plate operated; and the trigger arms G, H, I disengaged from their slots and pins. If, now, the pressure be brought down to 35-10ths or lower, the member A will be sufficiently collapsed by the weighted trigger plate to allow the disengagement of the arm from the pin, and allow the mechanism to operate—moving the rod F upward and turning on the gas at the burner.

When the rod F has almost completed its stroke, the pin on it comes into contact with the loose weighted lever and raises the latter. This removes 20-10ths pressure from the member A and allows the 35-10ths gas pressure to expand the same and operate the trigger plate H—the mechanism being stopped by the arm engaging with one of the pins on the governing wheel. At twelve o'clock midnight, when the pressure of gas is reduced to 15-10ths, the pressure on the member A due to the secured weighted lever (namely, 20-10ths) will overcome the pressure of the gas and collapse the member, allowing the arm to come out of engagement with the pin, and the mechanism will then complete the stroke of the rod F—the gas remaining in the "full-on" condition.

When the day pressure of 20-10ths has been applied and then reduced again to about 15-10ths, the mechanism will be allowed to operate; the rod F will be lowered; and the loose weighted lever will move down with it and put the full weight on the trigger plate. The mechanism will continue operating till the rod F completes its stroke, when it will be stopped by the engagement of the trigger arms before mentioned, and the mechanism will be in a position to repeat the cycle of operations described. The pressure of gas will need to be raised to about 40-10ths before the apparatus is again operated.

Furnaces for the Production of Smokeless Fuel.

COWPER-COLES, S. O., of Victoria Street, Westminster.

No. 27,833; Dec. 17, 1907.

This invention relates to furnaces consisting of a number of retorts arranged side by side in an oven adapted to be supplied with hot gases, which first pass into the space between each pair of retorts from one end to the other and thence flow laterally in opposite directions round the rear ends of each of the retorts "in such a manner as to ensure an even heating effect" for the production of smokeless fuel.

The retorts are of taper shape, with charging openings at the upper end and discharge outlets controlled by sliding doors at the lower end. They are mounted in series within a furnace of masonry having a number of grates so arranged that each of them supplies gases of combustion to adjacent retorts. Partitions are arranged between the front of each retort and the inner wall of the furnace extending from the top to the bottom of the retorts, and similar partitions are arranged at the rear ends of the retorts—the latter partitions, however, not extending to the top of the furnace, but leaving openings at their upper ends, so that the space within the furnace and surrounding the retorts is divided into a zig-zag passage through which the gases of combustion from the grates flow. The gases from each grate, therefore, pass up through the space between the two adjacent retorts from one end to the other, and thence laterally in opposite directions round the rear end of each; then forward along the other sides of the retorts to the front end of the furnace, whence they escape into a flue or chimney. By this means, in the case of each pair of retorts, the adjacent sides which are in direct communication with the grate are heated by the products of combustion therefrom; the other sides and ends of the retorts being heated by the divided current of gases—the residue of the heat required to maintain the outer sides of the outermost retorts and the ends of all the retorts at the same temperature as the first mentioned sides being obtained from the heat radiated from the masonry walls of the furnace in which the retorts are mounted. It will, therefore, be seen that the retorts are heated to an equal extent over the whole of the surface, "thereby obviating the disadvantages which attend the employment of retorts as hitherto used for this purpose."

The gases generated within the retort (and which contain the usual bye-products) are conveyed away from the upper ends of the retorts into a hydraulic main, the open ends of the discharge pipes being immersed in the water. From the hydraulic the gases may be conveyed through an air-condenser (where tar and heavy oils are deposited), and subsequently through a water-condenser for the condensation of the lighter oils. The purified gases from the water-condenser may then be passed through a scrubber and lime purifier to effect their desulphurization, and the purified gases may be conducted to a holder for storage in the usual way.

Fig. 1 is a sectional side elevation of apparatus constructed according to this invention. Fig. 2 is a sectional plan view. Fig. 3 is a cross section of fig. 1.

The furnace is constructed of masonry in the usual way, and there are three grates B provided at the front. C represents the retorts, six in number—mounted within the furnace—one pair of retorts in connection with each one of the grates. Each of the retorts is provided with a cover at its upper end through which it is charged, and at its lower end with a sliding discharge door. Underneath the furnace is provided with an arch for the passage of a truck into which the contents of the retorts may be discharged directly and conveyed away for storage or further treatment.

Fig. 1.

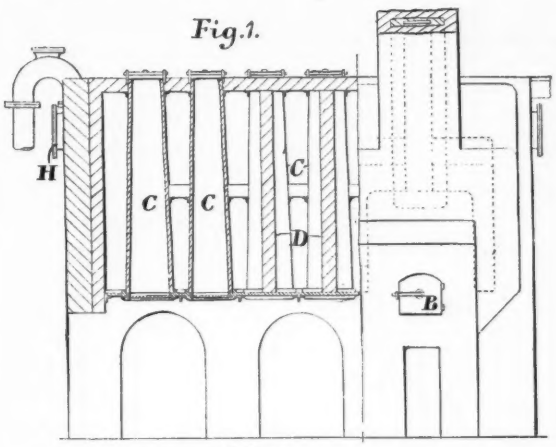


Fig. 2.

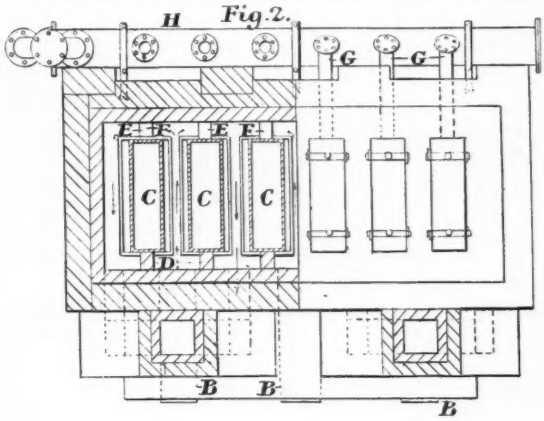
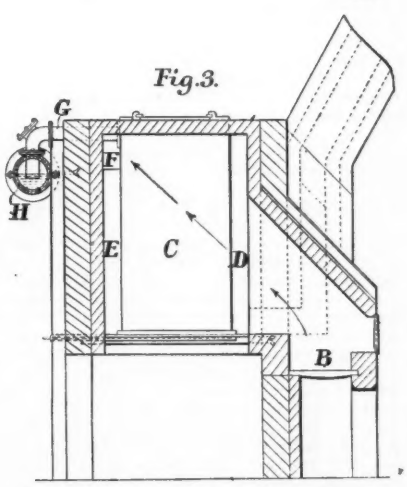


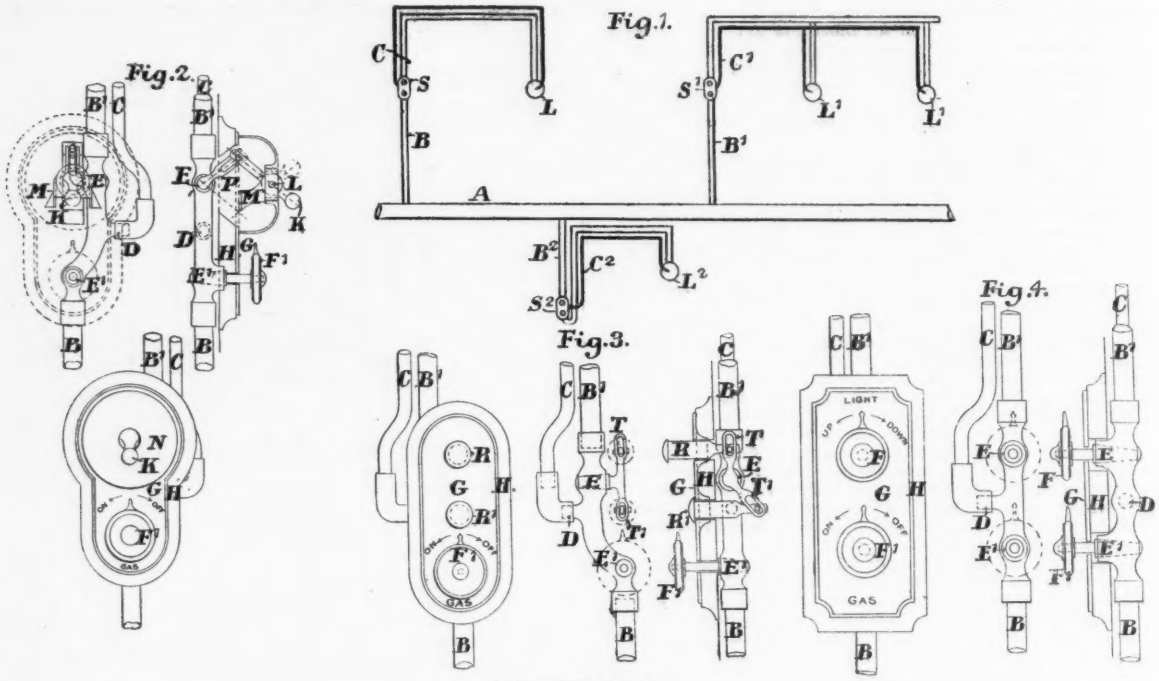
Fig. 3.



Cowper-Coles "Smokeless Fuel" Producer.

D are partitions between the front of each retort and the inner wall of the furnace. They extend from the top to the bottom of the retorts. E are similar partitions at the rear ends of the retorts. These partitions, however, do not extend to the top of the furnace, but have openings F at their upper ends. By this means the space within the furnace and surrounding the retorts is divided into a zig-zag passage through which the gases of combustion from the grates flow. G are the outlet pipes from the upper parts of the retorts; passing into a main H containing water into which the incoming ends of the pipes dip.

The furnace is employed in the following way: The retorts are filled through their upper ends, after which the top covers are sealed in position. The gases of combustion from the grates then pass around the retorts in the direction of the arrows—that is to say, the space which is in direct communication with the grate between each two contiguous retorts receives the full current of gases from one furnace; the other spaces between the retorts being heated by the divided currents of gases from two furnaces, and thus equalizing the temperature on both sides of each retort, except the outermost ones. The spaces at the ends of the retorts and the spaces between the end retorts



Andrews' Gas-Lighter.

and the furnace walls receive only a divided current of gases; the heat necessary to equably heat the contents of the retort being supplied by radiation from the fire-brick lining of the furnace.

Systems of Lighting by Gas.

ANDREWS, R. E., of East Dulwich, S.E.

No. 2300; Feb. 1, 1908.

This invention relates to "improvements in and relating to the easier and more convenient manipulation and control of lighting by gas, placing it in these respects more on an equality with electric lighting." The patentee has designed a system of gas distribution combined with a special switch which admits of the light in any room being turned up or down, or right off, as required, and which also provides for the gas supply being cut off from any room without interfering with the supply to other rooms connected with the same system. The invention broadly consists of a main supply pipe, from which branch pipes are led to wherever a light or series of lights is required. To each branch pipe a switch is fitted, so constructed as to admit of the passing of a supply of gas through two pipes connected to it—one for the supply of gas to a flash-light at the burner, and the other for the supply to the burner itself.

Fig. 1 is a diagrammatic sketch, giving a general idea of the system and the method of carrying it out. A represents the main supply pipe from the meter; and B, B^1, B^2 are branch pipes from the main supply to the switches and burners. S, S^1, S^2 are switches on the branch pipes—placed wherever desired for convenience in using. They may be brought together to a common switchboard, in the same manner as is done in electric lighting. C, C^1, C^2 are supply pipes from switches to small jet-lights at the burners. L, L^1, L^2 are burners from the branch pipes. The lights are controlled entirely from the switches, except in cases where more than one light is run from the same branch pipe. In such cases it will be necessary to turn off at the burners the lights that are not required. In all other respects the switch will control the whole of the lights on the branch (see B^1, S^1, C^1, L^1). B^2, C^2, S^2, L^2, show the manner of bringing the branch pipe, switch, &c., to the entrance to a room, &c., where the main supply is overhead.

Figs. 2, 3, 4 comprise in each case: Sight view, front elevation, with covering plate removed, and side elevation of three different kinds of switches—a lever switch, a push switch, and a disc switch. Each of the switches is complete in itself. The main part of the switches is practically the same in each case, and admits of the easy connection to it of the branch pipe B leading from the main, and also of B^1 leading to the burner. There are two valves, E and E^1, in each switch, of which E controls the light at the burner, and E^1 the supply from the main. The valve E^1 in each case is actuated by the disc F^1. Between these two valves is a nozzle D to which the pipe C is connected, which conveys the supply of gas to the small light at the burner.

This description is applicable to all the switches; but in the actuating of the valve E which regulates the light, the three methods adopted differ, and are as follows.

Lever Switch, Fig. 2.—This shows an arrangement for working the valve E, in which K is a lever working on a pivot L, attached to a bracket M which is fixed to the covering plate G. The bracket is formed so that the cap N can be screwed on to it as shown. The lever K actuates the lever P, and so turns the valve E.

Push Switch, Fig. 3.—In this case, the valve E is actuated by means of the pushes R R^1, which act on the levers T T^1 connected to the valve E.

Disc Switch, Fig. 4.—The valve E is worked by means of the disc F, in the same manner as E is worked by F^1.

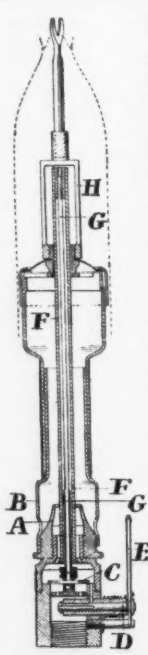
The method of using the switches is as follows: The valves E and E^1 are opened; thus admitting gas to the burner, which is then lighted. The supply best suited to the burner can then be obtained by regulating the supply by the disc F^1, which actuates the valve E^1. If the light is not required, it is turned down by the lever K, the push R, or the disc F (figs. 2, 3, and 4). This leaves the small jet-light burning so long as the supply of gas is not turned off altogether by closing the valve E^1. When using the push switch (fig. 3), in pushing in R to turn on the light R^1 will project out ready for use when it is wished to turn down the light.

Safety Gas-Burners.

ROTH, E., of Schöneberg, near Berlin.

No. 8511; April 16, 1908. Date claimed under International Convention, Nov. 29, 1907.

This invention relates to burners in which the gas supply is automatically cut off after the flame fed by the latter is extinguished. The closing of the gas-valve is effected by the difference of heat expansion of two bodies.



Roth's Safety Incandescent Burner.

The gas supply branch is provided at the top with a screwed-on cap, which carries the nozzle A with the mixing-pipe B, on which is mounted the burner-pipe proper. On the gas supply pipe is mounted a plate valve C; and it is provided with a cock D passing through its wall and provided with a handle E, made with a longitudinal groove which can be brought into communication with a perforation in the wall of the gas-pipe opening into the recess of the cap. A spring keeps the cock permanently in a position in which the groove is situated laterally of the perforation; so that the gas cannot pass through the groove and the perforation to the recess of the cap, except when the handle is turned.

The cap is connected by perforations to the interior of the nozzle, and is provided with a tubular heat expansion body F, the inner hollow space of which is in communication with the hollow space of the cap, and is connected at the top to a bar G, which has preferably a smaller expanding property than F. For instance, the heat expansion body can be made of brass, and the inner bar or rod of steel. The rod G carries at its lower end a sleeve provided with a head projecting into the hollow space of the cap; and the heat-expansion body projects centrally through the burner-head into a carrier H for the mantle support.

When it is desired to start the burner, gas is supplied through the groove of the cock D and the perforation, which is effected by turning the handle E in opposition to the action of the spring. As soon as the gas reaches the burner, and is lighted, the expansion body F is heated, which results in the raising of the rod G, which, owing to its connection with the expansion body F at the upper part of the latter, also expands. The extent to which the rod is thus raised depends on the difference of the heat expansion between the tubular body F and the rod G. Owing to the raising of the rod, the head of the sleeve which engages the rod with friction is lifted off the valve C. The valve, therefore, opens under the pressure of the gas, so that gas can pass to the burner in the normal way through the perforation in the cap. When the burner is extinguished, the head is lowered, and thus the valve C is closed, owing to the cooling of the heat expansion bodies. The closing can only be counteracted by again lighting the gas.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Sulphate Saturators.

SIR,—Mr. Pettigrew, in his letter in your issue for the 16th inst., distinctly states that he made no claim in his specification as to the thickness of the wall of the saturator; and he then proceeds to say that the "strength of the orifices"—which I understand to mean the thickness of the wall—"could only be ascertained by experience." Surely, after more than twenty years' experience in these details, it should have been quite easy for Mr. Pettigrew to have stated the necessary thickness of lead in order to prevent any material enlargement of the orifices; but I feel confident the possibility of enlargement was not in his mind at the time.

He further states: "That the better distribution of the ammonia gases by perforating the wall of the saturator at intervals was in my mind, is clearly shown by my specification. This is the principle." I am not aware that one is allowed to patent a principle of this kind. Anyone desiring to distribute a gas or a liquid in a vessel would perforate the pipe at intervals; and, after all, the wall of Mr. Pettigrew's saturator becomes a part of the distributing pipe or chamber.

I must still adhere to our claim, which is that by the use of small pipes from the main distributing-pipe the orifices do not become materially enlarged. Mr. Pettigrew admits he did not make a corresponding claim; and I therefore fail to see how we have infringed his patent.

Gas-Works, Poplar, E., June 18, 1908. P. E. WILLIAMS.

[We think the subject of the above letter has now been sufficiently discussed. Any further differences between the respective patentees must be settled elsewhere.—ED. J.G.L.]

Balloon Filling Extraordinary.

SIR,—I notice in your current issue a letter by Mr. Spencer under the above title, in which he refers to the arrangements that were made by the Gaslight and Coke Company for inflating the 31 balloons at Hurlingham last month. He gives it as his opinion that what he terms the second main, 100 yards in length, was unnecessary, and simply caused obstruction to the flexible boses leading to the balloons. I should like to point out, in justice to the Company, that the method of distribution was very carefully worked out by their Distributing Engineer, Mr. Foulger, before being applied, and that the second pipe in question was put down expressly for the purpose of equalizing the pressure over all the outlets, by what is termed "cushioning up." (A part of this pipe, with a special connection, was underground, and may therefore have been overlooked by Mr. Spencer.)

Mr. Spencer's suggestion, of merely having one pipe with 31 outlets, would, owing to the gas taking the line of least resistance, have obviously resulted in an unequal pressure being delivered at each of the 31 outlets; whereas the arrangement actually used gave an equal pressure throughout, so that all the balloons could be filled at the same rate. I may add that Messrs. Short Bros., of the Battersea Balloon-Works, who had the filling of all but one of the British balloons, made no such complaint, but were loud in their praises of the excellent arrangements of the Gaslight and Coke Company.

With regard to the black deposit which unfortunately entered some of the balloons, this was caused by oxide of iron being dislodged from certain parts of the main by the high pressure used, and owing to the direction of the gas being reversed after flowing one way for some eighty years.

Aëro Club, London, June 18, 1908. CHAS. S. ROLLS.

Sales of Stocks and Shares.

At the Mart, Tokenhouse Yard, E.C., last Tuesday, Messrs. A. & W. Richards placed new issues of gas and water capital by order of Directors. The first lots consisted of an issue of £2000 of 5 per cent. consolidated preference stock of the Falmouth Water Company; and it fetched from £108 to £109 per £100. A new issue of £3000 of consolidated ordinary stock of the Chigwell, Loughton, and Woodford Gas Company, ranking for a standard dividend of 5 per cent. per annum, subject to the sliding-scale, but carrying 5½ per cent. from the 1st prox., was placed at from £106 10s. to £107 10s. per £100. Some £10 "additional" shares (7 per cent.) in the Haywards Heath District Gas Company, carrying £9 12s. 6d. per cent. dividend from the 1st prox., fetched from £17 to £17 15s. each. A parcel of ordinary "C" stock of the Ilford Gas Company, ranking for a standard dividend of 5 per cent., but carrying 6½ per cent., realized from £128 to £130 per £100. At their sale-room in Bristol last Thursday, Messrs. George Nichols, Howes, Young, Alder, and Co. offered for sale by auction, in accordance with the announcement which appeared in our columns, £20,000 of 5 per cent. maximum general capital stock of the Bristol Gas Company. The highest amount bid for one of the lots was £115 10s., while the lowest buyers paid £114 10s. The whole £20,000 was sold, the sum bid being £22,968; giving an average of £114 16s. 10d. per £100, or £1 16s. 10d. above the minimum fixed. The Auctioneers also offered £8000 of new 4 per cent. debenture stock at a minimum of £100. The purchasers of eleven lots succeeded in getting them at this figure; and the highest price paid was £101 15s. The whole of the debenture stock fetched £8093 5s., the average being £101 3s. 4d.; while the aggregate amount paid for the stocks offered was £31,061 5s. Bidding was brisk; and the whole was disposed of in half-an-hour. A few days ago, Messrs. J. Carter Jonas and Sons offered for sale a new issue of £3000 of "C" stock (5 per cent.) of the Cambridge University and Town Gas Company. There was brisk competition, and the stock realized a total of £3476, or an average of rather under £116 per £100.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills brought from the Commons, read the first time, and referred to the Examiners: Burnley Corporation Bill, Criccieth Water and Improvement Bill, Padiham Urban District Council Bill.

Bills read a second time and committed: Garw and Ogmore Gas Bill, Wolverhampton Corporation Bill.

Bill reported, with amendments: Ammanford Urban District Council Water Bill.

Bills read the third time and passed: Blaydon and Ryton Water (Transfer) Bill, Draycott Gas Bill, Keighley Corporation Bill, Lincoln Corporation Bill, Ravensthorpe Urban District Council Bill, Wath and Bolton Gas Board Bill.

Bills Royal Assented: Dartford Gas Bill, Derby Gas Bill, Huddersfield Water Bill, Llanelly Gas Bill, Rochdale Corporation Bill, Skegness Urban District Council Bill.

The Gas and Water Orders Confirmation Bill (Sevenoaks and Stourbridge Water Orders) and the Margate Corporation Bill have been referred to a Select Committee, consisting of Lord Ribblesdale (Chairman), the Earl of Morley, Lord Templemore, Lord Leigh, and Lord Lochee; to commence sitting to-morrow.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Bills brought from the Lords, read the first time, and referred to the Examiners: Keighley Corporation Bill, Ravensthorpe Urban District Council Bill, Wath and Bolton Gas Board Bill.

Bills read the third time and passed: Burnley Corporation Bill, Criccieth Water and Improvement Bill.

The Holderness Water Bill and the Provisional Order (No. 3) Bill—the latter to confirm a Provisional Order relating to the boroughs of Burslem, Hanley, Longton, and Stoke-upon-Trent, and the urban districts of Fenton and Tunstall—have been referred to a Select Committee, consisting of Sir Frederick Cawley (Chairman), Captain Clive, Mr. Mond, and Mr. James Haslam; to commence sitting to-day.

PORT OF LONDON BILL.

The Joint Committee of both Houses of Parliament appointed to consider the Port of London Bill have held several sittings during the past fortnight.

The Counsel for the Bill are the Hon. J. D. FITZGERALD, K.C., Mr. VESEY KNOX, K.C., Mr. W. B. CLODE, Mr. GODLEY, and Mr. RAYMOND ASQUITH. The petitions in opposition include those of the South Metropolitan Gas Company, the South Suburban Gas Company, and the Commercial Gas Company, for whom Mr. HONORATUS LLOYD, K.C., Mr. ROSTRON, and Mr. BERNARD WILKINSON appear, and the Gaslight and Coke Company, represented by Mr. RAM, K.C. Appearance was entered on behalf of the Wandsworth and Putney Gaslight and Coke Company; but Counsel was reserved.

Mr. *Llewellyn Smith*, the Permanent Secretary of the Board of Trade, having given evidence in support of the Bill,

Mr. HONORATUS LLOYD cross-examined witness on behalf of the three Gas Companies represented by him. Witness agreed that these Companies were large importers of coal. It was desirable that a majority of the Board should be elected, and that the majority should come into existence with all possible speed. He was afraid, however, it was impossible for this to happen in less than three years.

Mr. HONORATUS LLOYD: Is there anything to prevent a Board being elected on the registers which at present exist, with possibly a nomination by the Board of Trade, after consideration and consultation with gentlemen to represent the payers of dues?

Witness: I do not know of any registers which exist which could be adapted for the purpose. If suitable registers exist, I know of no difficulty. It seems to me, however, inconceivable that there can be a register for the purpose.

Pressed as to whether it must necessarily take three years to provide a register, witness pointed out difficulties connected with the compilation of a register of dues-payers, and that there was no such separate register now in existence.

Mr. HONORATUS LLOYD: Is it your intention to levy dues on goods which simply pass through the limits of the port without being landed or unshipped in any form?

Witness: No.

Will you tell me why, in clause 36, you have a saving clause for vessels passing through the Port of London; and when I read the clause I find it is limited to passing through between certain rivers?—I think they had protective clauses put in to meet apprehensions on the part of a particular set of people interested in a particular group of trades.

A vessel carrying coal from Newcastle, entering the mouth of the river, passing through the limits of the port, and then into the River Lea, and discharging there, would pay no dues?—I think that is so.

That is intended?—I wish to guard myself. I must go into the details of the clauses to see that I have not made a mistake.

Lord LEITH (a Member of the Committee): She pays tonnage dues?

Witness: Yes.

Goods coming through the port in this way enable the port to earn tonnage dues?—On the ship, yes.

Mr. HONORATUS LLOYD: Clause 36 is not to be construed as putting any dues on vessels or goods under the conditions mentioned in that clause.

The CHAIRMAN: I suppose the principle which applies to the River Medway and the River Swale will also apply to the River Lea.

Mr. HONORATUS LLOYD: That is what I want to know; and, if not, why not.

Witness: When we get to the reservations for particular districts, one has to walk warily. I did not know you were going to examine on this clause; and I did not want to be trapped into an admission I might have to go back upon. I do not use the term offensively.

It is for this reason I put the special instance I had in my mind?—If I find I have incorrectly stated it, I will alter it. In general, I should not intend that the words "goods imported into the Port of London" should be held to cover goods carried right through the Port of London to some other place without disembarking.

In cross-examination by Mr. RAM, witness accepted the statement that the Gaslight and Coke Company obtain almost all their coal—1,560,000 tons per annum—by sea, and agreed that probably the ships bringing it were of shallow draft. No doubt these vessels could use the undredged channel of the river. Certain expenditure, including dredging, was estimated at £130,000. About half the sum named would be required for dredging.

Mr. RAM: Whatever the expenditure on dredging, coal will have to pay dues in respect of the dredging, even though the Gaslight and Coke Company are in no way benefited by it?—Yes; if dues are put on coal.

It is intended to put dues on coal, is it not?—It is intended that the Port Authority should prepare a schedule of maximum rates within a certain period and submit them to the Board of Trade; and objectors will be heard. I am sure the Gaslight and Coke Company would be one of those who would be heard. Finally, a maximum schedule will be approved by Parliament.

You will recognize that this particular trade could not be transferred from the Port of London to any other port?—And therefore it would bear taxation, you mean?

And therefore, if it is to bear taxation, it is helpless. It must bear whatever is put on it?—I understand your point.

We must bring the coal to London in order to make gas in London?—Yes.

In further cross-examination, witness said £180,000 had to be provided yearly out of revenue for new works, dues on goods, and registration fees on river craft. The larger portion of this sum he hoped would come, not from dues on goods, but from revenue from new works.

Mr. RAM: This trade being peculiar in the ways I have pointed out, and no advantage being derived by the trade from the large amount of dredging, whatever it may be, do you think it unreasonable for us to ask that there should be special regard had to vessels carrying coal into the Port of London, and bound to carry coal into that port?

Witness: The chief argument used by the other Counsel has been diametrically opposite. They have pointed out that a small due on coal would divert traffic from the port. Your argument is that this traffic could stand a fairly high due. I do not know on what ground I am to say that coal deserves special treatment.

My point is not that it will stand a high due, but that whatever is put on it, it must pay, because it cannot go elsewhere?—That is what I mean by standing a high due.

It will have to bear it. That is the way to put it?—I have admitted to other Counsel that coal is an article which deserves very special and careful consideration as regards the dues which it could bear. But I have been chiefly actuated in that reply by consideration of the competition between railway-borne and water-borne coal, and the extent to which any large due on coal might divert trade from the port.

You do not suggest that while you would relieve the heavy dues on coal which could be taken elsewhere you would hit exceptionally hard the coal which is helpless because it must be consumed in London?—I am not the Port Authority.

You come very near it, I think. You will have a voice in it. Do you think it would be reasonable when vessels come into port very frequently and remain only a short time, and get no good from the dredging, that there should be a remission made in respect of fees on goods carried in those vessels?—On the goods, or on the vessels?

On the goods?—No; I do not see any reason for it.

Perhaps it would be right to ask for it on the vessels and not on the goods?—Yes; I thought so.

Very well; I will say the vessels?—You mean the maximum due after a certain number of voyages?

Yes?—I do not know whether there is anything of that kind with the existing Thames Conservancy tonnage dues. I do not know whether there is any limit. If there is, of course, it will be taken over into this Bill.

But if there was not?—Then it would be a matter which ought to be considered—which might be considered. Our attitude is rather to take over things as we find them.

Not quite. I see you are estimating to get £66,000 a year for increased tonnage dues under the Thames Conservancy Act of 1905?—They are now in force.

But these exceptional dues come to an end in three years from the time they were imposed?—The Thames Conservancy are promoting a Bill to extend them.

So are you?—I know; but if our Bill was out of the way, the Thames Conservancy Bill would be before this or some other Committee.

Other evidence having been given, the Committee adjourned.

The Eight-Hours Bill.—Speaking at a meeting of the Plymouth Chamber of Commerce last Friday on the effect of the Mines Eight-Hours Bill, Sir Joseph Bellamy, Chairman of the Plymouth Chamber of Commerce, said that the collieries insisted on the insertion of a clause in their contracts with the gas companies that the price of coal should be advanced 1s. 6d. per ton if the Bill became law. This, to the Plymouth Gas Company, was equivalent to an advance of 2d. per 1000 cubic feet in the price of gas. The users of coal would, of course, have to pay an increased price for their coal as well as more for their gas. Just now, when in Plymouth they were hoping to see prices reduced from the high level caused in part by the abolition of the coal duty, it was disastrous that something should be done by the Government which would have an opposite effect.

MISCELLANEOUS NEWS.

THE NEW GAS-WORKS AT KIRKINTILLOCH.

The Opening Ceremony.

Last Wednesday afternoon, the new gas-works which have been erected by the Corporation of Kirkintilloch at Back o' Loch, were formally opened. A description of the works was given in the "JOURNAL" for March 10 last (p. 625), and need not be repeated. The attendance was not large, and included very few gas managers, most of whom were in London at the time. Having assembled in the exhauster-house,

Provost SERVICE said the works might be taken as an outward and visible sign of the progress and improvement of the town. The old gas-works had been completely crowded out; and for a long time the Gas Committee had had the utmost difficulty in keeping them in such a condition as to ensure an ample supply of gas to the community. Indeed, for the last year or two there were times when they had a feeling of despair in regard to the possibilities of finding the town in darkness, in the short winter days. The old works had served the town for nearly sixty years. They were started by a small Company; and it was curious that, a few days before, in reading some books, he discovered that the origin of the Company was a gathering in a public-house of a few of the more important personages of the town. At this gathering they decided that Kirkintilloch should be lighted by gas. They formed a Company; and the money subscribed to start the works was £1000. These were the works which still remained beside Kirkintilloch Railway Station. When the Act was passed which gave town councils authority to take up gas-works, their Council decided that it was the right thing to do; and they acquired the gas-works at the price of £14,000. Judging from the many muttered grumbles and complaints from the community, the opinion seemed to have been that the Gas Company had made a very good sale. However, the works had constantly progressed. The town had grown, and the demand for gas had also grown, until it had been found impossible to continue longer upon the old site. Consequently, after much thought and deliberation, with the guidance of experts, it was decided to acquire ground there, and to proceed with the erection of these new works. The operations had been going on for some years. There had been expended on the old works £23,000; and of this £16,700 had been repaid, leaving only £6300 as a debt upon them—a very modest sum, and one which would give to the Convener no trouble in handling now that the new works were opened. The new works had been built under the supervision of the late Gas Manager and the present Gas Manager; and he thought there was nothing which science or skill could devise, to make them up to date and capable of producing cheap gas, which was not to be found there. The people of Kirkintilloch would be proud of the works, because they would get gas as cheap as, perhaps cheaper than, any other town in Scotland. There was a still older gas-works in the town than those at the Railway Station—at Waterside. Probably few people knew of the existence of these works. They were of small dimensions. He had been told that the man who made the gas in the works was paid a wage of 12s. a week; and when he claimed an advance in wages, the Chairman of the Directors thought it was a piece of arrogance not to be tolerated, and that the man could leave and he would do the work himself. The Chairman started to do the work; and he melted the retort. A new retort was obtained; and the Directors were so pleased with the skill of the Chairman, that they advanced his wages to 15s. a week. The new retort got twisted and cracked; and the remedy which the Directors suggested was that it should be fired a little harder—and perhaps the pieces would come together again. The works they had now erected were for the service, not only of the present day, but of the community in times to come. The Gas Committee had, under the wise supervision of their Convener (Bailie Perry) constructed the works in such a way that, whatever happened, there would be provision for the supply of gas for all the wants of Kirkintilloch for lighting or for any of the other purposes for which gas was used, for fifty years to come. He had to ask Mrs. Perry, the wife of the Convener, to honour them by turning on the exhauster, thereby formally opening the works; and he hoped the ceremony would be a happy augury of success to the new works.

Mrs. Perry having set the exhauster going, Mr. Fred Brockway, of Messrs. R. Dempster and Sons, Limited, of Elland, on behalf of the Contractors, presented to her a silver rose bowl, with an inscription, which he read.

Bailie PERRY, on behalf of his wife, thanked the Contractors for their kindness. He said he could assure them that it was a day of great pleasure to himself. He had had in the works many uncomfortable hours of difficulty; but those were all past now, and this presentation would remind him of the duties he had gone through.

Mr. R. Graham, of Messrs. R. Graham and Son, Kirkintilloch, presented to Provost Service a pair of silver candlesticks, bearing an inscription; and Provost Service returned thanks for the gift.

Some time was spent by the visitors in viewing the works, after which they drove to the Town Hall, where luncheon was served, and a toast list was gone through.

County Councillor W. SPEIRS proposed "The Provost, Magistrates, and Town Council of Kirkintilloch," who had, he said, given much time, attention, and anxious thought to the works they had just opened. The knowledge and skill of the Convener in chemical affairs had enabled him to make the works the success which they were all confident they would be.

Provost SERVICE acknowledged the toast.

Deacon Convener M'DONALD (Glasgow) proposed "Success to the Gas Undertaking of Kirkintilloch," and in doing so said that James Watt and William Murdoch had added to the wealth of the world; and he was not sure but that Murdoch had added more to the comfort of the world than even Watt. It was a great satisfaction to think that gas had received a new lease of life through the incandescent burner and mantle. They in Kirkintilloch had entered upon a new enterprise in connection with the gas undertaking. They had a fine works, nicely

laid out; and for this they were largely indebted to the wisdom and the able experience which Bailie Perry had given to the matter.

Bailie PERRY said he believed that now they had started their new gas-works matters would go on more smoothly and successfully than in the past. They had had many difficulties at the old works, and constant complaints; and they had been threatened, time and again, to be taken into the Law Courts, on account of the smoke and smell emitted. They were very much cramped for room; and they found that they could not introduce the newer plant which was necessary. When they went down, also, they struck water, which was a great difficulty. They made wells, and had pumped water out of them every hour of the day and night for the past nine years. If the pumps had broken down, the fires would have gone out. He was quite sure they had done a very good thing in building new works; and they had reason to be proud of the success they had attained. There were only three works in Scotland which supplied gas at a cheaper rate than they did in Kirkintilloch. One of these places was Glasgow; and the difference between them was 1d. per 1000 cubic feet. Now, when they had got their new works, he was not sure but that they might be able to make gas cheaper even than in Glasgow. There was a very fine feeling among gas engineers. They all assisted each other, and gave each other help in every possible way. They showed their works and all the latest improvements to each other; and whenever anyone was able to sell gas more cheaply than the rest, the others were the first to congratulate him. They were very much indebted to the Gas Engineer of Glasgow, for the assistance he had given them on many occasions. They were now looking forward to having better times. He believed that a large amount of their success in the Gas Department in the past was due to their having been fortunate in getting most excellent young men as Managers—young men full of energy and knowledge, and determined to get on. That they did not stay long with them was, he thought, the very best test of their worth. Mr. W. Wilson, their late Manager, who was with them that day, spent many long arduous hours in drawing out the plans of their new works; and they wished to congratulate him on the success of these plans. The fact that the Gas Engineer of Glasgow was consulted with regard to the plans, and that he altered them very little, showed that they were very well drawn out. They hoped that they were entering upon quieter and more easy times in regard to the manufacture of gas.

"The Contractors for the New Gas-Works," was proposed by Councillor Major WALKER, and responded to by Mr. F. BROCKWAY.

The toast of "Our Guests" was proposed by Bailie ARMSTRONG, and responded to by Mr. T. DUNCAN, of Woodhead, and Mr. W. EWING, of Greenock, who described the new gas-works as being about as perfect as the hand of man could make them.

"The Gas Manager" was proposed by ex-Bailie W. ALEXANDER, and responded to by Mr. J. MACLEOD.

MANCHESTER CORPORATION GAS SUPPLY.

No Reduction in Price—Relieving the Rates from the Profits.

A Special Meeting of the Manchester City Council was held last Wednesday—the MAYOR (Alderman Holt) presiding—to consider various matters left over from a previous meeting; among them being the question of reducing the price of gas, which had arisen on a motion standing on the *agenda* in the name of Mr. Doyle. He proposed that the price of gas to ordinary consumers for lighting purposes should be 2s. instead of 2s. 3d. per 1000 cubic feet; that consumers by prepayment meters should be given 33½ instead of 30 cubic feet for 1d.; and that the illuminating power of the gas used for lighting purposes should be not less than 17·50 candles.

When the matter was reached, Mr. DOYLE said that since he gave notice of the resolution the position had altered owing to a revision of the estimates involving a further call upon the profits of the Gas Department. This being so, he desired to withdraw his motion, because, in view of the decision of the Council as to the extra sum required, his proposition could not be carried out if adopted.

Alderman GIBSON (the Chairman of the Gas Committee) objected to the withdrawal of the motion; pointing out that he had been at considerable trouble to prepare a statement on the subject for the benefit not only of the members of the Council but of the public generally.

The Council having decided that the resolution should be proceeded with,

Mr. DOYLE moved its adoption, and presented a statement showing that gas was sold cheaper in other towns—such as Bradford (2s. 1d.), Leeds (2s. 2d.), Sheffield (1s. 4d.), and Widnes (1s. 2d.), than in Manchester. It was his contention that Manchester, being as favourably situated as these towns for the purchase of coal, should have cheaper gas; and he also argued that the time had come when they should give up taxing one section of the community for the benefit of another.

Mr. ROSS CLYNE, in seconding the motion, read a letter he had received from Widnes which set forth that if the Engineer were given a free hand, Manchester could have its gas as cheap as it was sold in that town.

Mr. HARGREAVES pointed out that the cost of production of gas was 11½d. per 1000 cubic feet in Sheffield and 12½d. in Manchester, and asked why it was that there was so great a difference in the cost of retailing it in the two towns. He held that the price ought to be reduced so as to enable the citizens to use gas instead of having coal-fires.

Mr. W. T. JACKSON stated that a few weeks ago he would not have voted for the motion; but, in view of the Council's action on the estimates, he now supported the mover. The Gas Department had been called upon to contribute out of the profits £70,000 in aid of rates; and the important principle involved was whether a trading department should be run for the relief of the rates, or for the public convenience. This farming of the trading departments for rate-relief was a pernicious practice, and was a perversion of the legitimate function of the public service. It was bungling finance, and to be condemned from a public point of view. Cheaper gas, he went on to say, would mean a healthier city, and would lead to a saving of the ratepayers' money, because they would have smaller profits on which to pay income-tax.

Alderman GIBSON said that, while he agreed with the principle of the motion, he could not, paradoxical as it might seem, vote for it. If they had to adopt Mr. Doyle's suggestion, it would mean striking out, at one stroke of the pen, £70,000 of the profits of the Gas Department. On this question of subsidizing rates out of trading departments, he declared the principle to be wrong. He had made a study of the subject for twenty years, and was certain of his ground. Eight years ago, he invited the Council to adopt a resolution condemning the subsidizing of the rates out of the gas undertaking, as wrong in principle and inimical to the best interest of the ratepayers. At that time, however, there were only eight wise men to be found in the Council, as only this number voted in favour of his proposal. When the decision was announced, he ventured to say that his opinions on the subject would sooner or later become those of the majority of the citizens and of the Council; and he thought he could now claim that his prediction had proved correct. He felt certain that were he to propose a similar resolution to-day, it would not receive eight votes, but many times eight. People were beginning to see the fallacy of the policy pursued by the Council for so many years in regard to the gas undertaking; they were beginning to see that giving to the rates was not relieving the ratepayers, and that they were relieving those who were best able to pay, by taking money from the pockets of those who could least afford it. Only a few weeks previously, he demonstrated this to the Council, and showed that 26 large firms, paying some £56,000 a year for electricity, were given £2216 taken from the gas consumers' pockets. They gave this sum to 26 consumers; and he asked the Council to remember that there were on the books of the Corporation 7000 consumers. From this they would realize what a large amount was taken from the users of gas to relieve these people. Was this kind of procedure honest? Gas was never cheaper in Manchester than now; and no other city gave its customers the facilities afforded in Manchester with regard to stoves and other fittings. Yet, in spite of this, people kept on making all kinds of suggestions but the right one—the only one which could have the effect of reducing the price of gas. So long as they took from the gas profits £1000 a week for the relief of the rates, they would never have a reduction in price. He asked them to consider what would have been their position to-day if they had not followed the course adopted by the Council in regard to taking profits from trading departments? They would have had gas-works worth £3,000,000, clear of debt, and they would have been selling gas at 1s. 6d. per 1000 cubic feet. Since the Corporation acquired the gas-works in 1843, they had made a gross profit of about £6,000,000. What had they done with it? A sum of £2,700,000 had been spent on the works, £1,415 000 had been paid in interest on money which ought never to have been borrowed, £1,405,000 had been applied in redemption of capital, and £2,858,000 they had actually given away. The amount paid for borrowed money and that given away came to £4,273,000—a sum which ought not to have been taken out of the gas consumers' pockets. This large profit should have been used for the benefit of their own business in the way in which every good business man would employ his money. He (Alderman Gibson) could not see why municipal business should not be conducted on the same lines as ordinary business. So long as they bolstered up the rates by taking the profits of the Gas Committee, they would, as he had said before, never have cheaper gas. Until the gas consumers woke up and realized how they were made to pay for the rates of people who were not gas consumers, nothing could be done. Referring, in conclusion, to prepayment meters, Alderman Gibson said there were now 60,000 of them in use in Manchester, and there was never less in them than £5000. It cost 6d. per 1000 cubic feet to collect the money from these meters, compared with 1d. for the ordinary accounts; and it had been suggested that they ought to collect once every two months instead of monthly. If this were agreed to, they would lose interest on the £5000 for a month, and would also increase the temptation offered to break open the meters.

Alderman PLUMMER held that the system of using a portion of the gas profits in aid of rates was sound from an economic point of view, and tended to the advantage of the ratepayers as a whole. The policy of the Council received the weighty support of Sir Joseph Heron so long ago as 1873; and, in his opinion, no reason had been advanced to show that it was wrong.

A councillor rose to continue the discussion, when, in view of the amount of business on the *agenda*, the closure was moved. This was agreed to, and Mr. Doyle's resolution was rejected.

The Quality of the Gas.

The reply of Alderman Gibson to the complaints as to the quality of Manchester gas, to which reference was made in the last number of the "JOURNAL" (p. 718), has not satisfied Canon Nunn, of St. Thomas's Church. Writing to the Lord Mayor on the subject, the Canon asserts that the reply of the Chairman of the Gas Committee consists chiefly of an attempt to dispute the fact of the general dissatisfaction with the gas supply, and an effort to throw the blame of the bad light upon the fittings in use in the church and school. With reference to the diminution of the illuminating power of the gas, Canon Nunn quotes from a statement made by Mr. Norbury Williams, the Public Auditor, in December last, to the effect that the illuminating power of the gas had gradually diminished from 20·14 candles in 1889 to 18·37 candles in 1901, and to 15·30 candles in 1906. As Mr. Norbury Williams's table was taken from the official report of the Gas Committee, Canon Nunn cannot understand how Alderman Gibson can describe his statement as "not correct." "We can only conjecture," he adds, "that the mixture of the gas varies according to the will of the officials, and that the Gas Committee are satisfied with themselves so long as they are able to count up their 'profits.'"

Canon Nunn goes on to say that some years ago three chandeliers sufficed for lighting the church; and now five are insufficient. He thinks it is idle to say that the fittings are old-fashioned, as they have been renewed from time to time in recent years, and in his opinion are sufficient for all purposes if gas of good illuminating power is supplied. "A clear explanation of the facts is needed," says the Canon; and he then proceeds: "The Gas Committee were appointed, as I understand it,

to supply the city with coal gas. They have found that by mixing the gas with carburetted hydrogen a gas is produced which gives a brilliant light where incandescent mantles are used, and at less cost. The Gas Committee have been gradually reducing the illuminating power of the gas. The Chief Engineer has expressed his wish to reduce it still further—*i.e.*, to 10-candle power. 'This,' he said, 'would open out immense possibilities in the cheapening of gas.'" After setting out a series of questions to which he considers the public will require to have some answer, he says: "One thing is clear. The present state of things is intolerable and a public scandal, and we look to our city councillors to relieve us from the plague of darkness, even if we decline to provide mantles and costly fittings."

The officials connected with the Manchester Gas Department are not inclined to take Canon Nunn seriously; and while admitting that some complaints have been received as to the gas supplied, they still hold that these arise principally from the use of old pipes and fittings. The complaint made by the Droylsden Council has now been satisfactorily explained. A quantity of bad gas got into the mains accidentally; and it took some time to drive it out. In the case of St. Thomas's Church, it is pointed out that the building is an old one; and though the fittings may have been renewed as stated, the pipes are the same.

On the question of the low price of gas at Widnes, Alderman Gibson, the Chairman of the Gas Committee, supplementing what he said at the Council meeting, points out that the conditions are not the same. The price in Manchester is fixed so that £50,000 per year can be paid in relief of rates; and this time an additional £10,000 is to be taken from them. As he stated to the Council, this was not his policy, and he does not believe in it. Again, large sums are every year paid by the Manchester Gas Committee in interest and sinking fund; while in Widnes the amounts are comparatively small. If the £50,000 per annum had been applied otherwise, the whole condition of affairs would have been altered, as the Corporation would have been using their own money instead of borrowing. In the three years following the acquirement of the gas-works in 1843, a profit was made of £83,000, equal to the purchase money; and from that time the expenditure and profits have been as follows:—

	Expenditure.		Profits.
1850-60	£290,000	..	£554,000
1860-70	£399,000	..	£672,000
1870-80	£687,000	..	£1,172,000
1880-90	£562,000	..	£1,462,000
1890-1900	£803,000	..	£1,187,000
1900-8	£579,000	..	£1,317,000

FATALITY AT THE BECKTON GAS-WORKS.

Last Wednesday, Mr. G. E. Hilleary, the Coroner for West Ham, held an inquiry, in the Public Hall, Canning Town, into the circumstances attending the death of Henry Jolly (62), in the service of the Gaslight and Coke Company. Mr. Luxton (Messrs. Monier-Williams, Robinson, and Milroy) watched the proceedings on behalf of the Company. Henry Wells, the head ganger, deposed that the deceased, with eight other men, was engaged on the previous Saturday in loading a barge with retort carbon from the quay side at the Beckton Gas-Works. There were four waggons, and he instructed the brakesman to pull them two at a time on to the road alongside the quay. The first two were drawn up, and he gave orders for them to be moved to make room for the next two. He was about a yard in front of the horses' heads, and did not see the deceased and a man named Price on the waggon. The first thing to which his attention was called was Price jumping off the buffer of the waggon on to the land side. The waggon was then in position for unloading. Price told him Jolly was down in the barge; and he afterwards saw him lying there in front of the hold. The men had no orders to get on to the waggon until it was in position. William Fairhall, the brakesman, having given evidence, John Price said he did not see the horse attached to the waggon; but there was a sort of jerk, and he jumped off the buffer on the land side and Jolly on the water side. The distance from the buffer of the waggon to the quay was about 2 ft. 6 in., and from the quay to the barge about 9 or 10 feet. He did not hear any orders given for moving the waggon, or he would have jumped off, and told Jolly to do the same. He thought they were going to unload only two waggons; and he knew nothing about the others. It was no doubt a misunderstanding. Charles Yendall, a general labourer, said he was standing looking at the driver, and when the horses pulled someone called out. He looked round, and saw the deceased going over the side of the quay. Dr. H. R. Davies, the House Surgeon at the Seamen's Hospital, said the deceased was admitted on the morning of the accident suffering from a fractured spine, and died the next morning; the cause of death being failure of respiration through injury to the spinal cord. The Jury returned a verdict to the effect that the deceased died through injuries caused by being thrown off a waggon on to a barge at the Beckton Gas-Works, and that he met with his death by misadventure.

Cleckheaton Gas Undertaking.—The official report of the gas undertaking of the Cleckheaton District Council for the year ended March 31 shows a net profit of £2571. In the preceding year it was £3791; but twelve months ago the price for lighting was reduced by 2d., and for trade purposes by 6d. per 1000 cubic feet, and 1d. in the shilling was allowed to prepayment meter consumers.

Skipton Gas Undertaking.—At a meeting of the Skipton Urban District Council last Thursday, the Chairman of the Gas Committee (Mr. W. Graham) submitted his annual financial statement. He referred to the pending installation of machine stoking and coke-conveying plant, and additions to the retort-house, and claimed that these would enable the works to meet all demands for a number of years to come. Notwithstanding the advanced price paid for coal, increased discounts to consumers, and higher wages to workmen, there was a net profit for the year ending March 31 of £627. It was considered that the result reflected great credit on the management of the undertaking.

OSSETT CORPORATION GAS UNDERTAKING.

The Past Year's Working.

At the Meeting of the Ossett Town Council on the 10th inst.—the first held in the new Council Chamber in the Town Hall—the minutes presented by the Gas Committee contained the report of the Engineer and Manager (Mr. A. E. Mottram) on the working of the gas undertaking in the twelve months ending the 31st of March.

Mr. Mottram commenced by expressing his pleasure at being able to report a successful year's working and a large increase in the consumption of gas. There had been made 117,015,000 cubic feet, and sold 108,155,800 cubic feet—being an additional make of 5,254,000 cubic feet, and an extra sale of 5,977,200 cubic feet. The unaccounted-for gas had been reduced to 7½ per cent. The tons of coal carbonized were 10,732; and the number of cubic feet of gas made per ton, 10,903. There was a gross profit of £8136; but the interest and sinking fund charges amounted to £6637, the final instalment of the retort-house suspense account (£1360) had been paid, and the "slot" fittings account reduced by £139. There were 3750 consumers by ordinary meters, and they used 61,669,200 cubic feet of gas in the year; the prepayment consumers numbering 3295, and their consumption being 21,836,300 cubic feet. The total number of consumers—7045—is 290 more than it was at the end of the financial year 1906-7. The cost of gas per 1000 cubic feet sold in the period covered by the report was 1s. 1·63d.; the gross cost of production and distribution being 2s. 3·26d., and the net cost 1s. 5·6d. Adding the capital charges, the total cost is brought up to 2s. 8·32d., compared with 2s. 7·48d. before. Mr. Mottram remarked that they had been compelled to raise the price of gas owing to the 25 per cent. increase in the cost of coal; but they would be able to buy in the current year at a small reduction. They would have to meet a loss of income from tar of 25 per cent.; it having now fallen to a very low price. Ammoniacal liquor had continued steady; and the coke market had been good and remained firm.

In moving the approval of the minutes, the Chairman of the Gas Committee (Mr. H. Robinson) remarked that there were several things in them of considerable interest; but the Manager's annual report overshadowed everything else. It must be pleasing to the Council as well as to the public to learn of the successful result of another year's working. This success was attributable in the first place and in a large measure to the Manager, who, by growing ability, increased interest, and enthusiasm, had made the success of the year a possible thing. He must also allude to the willing and industrious services of the staff, and to the assistance rendered by the members of the Gas Committee, who, though they could not go into the scientific and technical details of gas making, had entered with zest and discretion into the financial side of it. In addition, they had, fortunately, the loyalty and interest of the public, without which even good management could not make the gas undertaking the success it was. In order to maintain the position and improve it—and they must do both—they would have to merit it; and in this connection he announced that an exhibition, with a series of lectures, would be held to demonstrate the utility and value of gas in domestic life. Though the success in the past year had been phenomenal, there were one or two galling facts connected with it. They had had to increase the price of gas, not because of any defect in the works or weakness in the management, or anything outside the works over which they had control, but simply through the enhanced price of coal, which had cost £1372 more than in the previous year, though only 466 tons more had been used, and though the higher price was charged only during half the year. The increased price of gas was one of the things that took the gilt edge off their success. Another was that they anticipated five or six years ago substantial relief to the rates from the gas undertaking, better lighting of the streets at no cost to themselves, and innumerable other advantages; but, notwithstanding their labours—and no man could calculate the amount of labour, paid and voluntary, that had been put into the undertaking—years of anxious concern, and financial responsibility, they had not reached these great blessings yet. They rejoiced in a record make and sale of gas that could not have been anticipated by the most sanguine man when the works were acquired; and it was this that had saved them from disaster. They had made 117,015,000 and sold 108,155,800 cubic feet, which again evidenced the popularity of gas, and demonstrated that for lighting and heating it was without a serious rival. It was marvellous to him that the rate of increase had been maintained for six years. The quantity of gas made in the twelve months just closed was 5,264,000 cubic feet more than in the previous similar period; and 32,789,000 cubic feet more than in the year prior to the gas undertaking coming under the control of the Corporation; while the gas sold was 5,977,200 cubic feet and 31,312,300 cubic feet more respectively. Then came a most significant and valuable thing. They saved in leakage in the past year, compared with 1906-7, 713,200 cubic feet. During the last six years, the leakage had been reduced from 15 to 7½ per cent.; representing in round figures £600, notwithstanding the fact that they had an increased length of mains by 15 miles, and had to raise the pressure in order to send a larger volume this greater distance. They had in their first year 3452 consumers: in 1906-7 they had 6755; and last year 7045—an increase since the first year of 3593. This led him to believe that they would have to look in future for increased consumption by their present customers rather than for an additional number, because they had a customer in almost every house in the district served. The extra consumption had been fairly equally spread over the district. As to the distribution, the consumption by ordinary meters had increased by 1,093,200 cubic feet, by slot meters by 1,664,600 cubic feet, by the public lamps by 38,200 cubic feet, at the works by 254,900 cubic feet (which the Manager would perhaps bear in mind), by gas-engines by 2,184,100 cubic feet, and by cookers by 742,200 cubic feet. With regard to slot meters, there were 1009 consumers who of their own choice preferred this method of supply. It was a strange thing to him, and he could not understand it at all. These consumers were taxing themselves severely, inasmuch as they were paying more than the others for their gas; and at the same time they were an increased

expense to the Committee. With regard to the 2210 consumers whom they compelled to take gas by this method, the Corporation having put in the fittings, he had great sympathy with them, for they were among the poorest; and it was a shame on the landlords that they should see their tenants taxed in this way in order to save themselves the trifling cost of the fittings. While the increased consumption by cookers was not so large as they would have liked—probably the bad summer accounted for it—there was sufficient increase to prove that cooking by gas was giving the highest satisfaction; and he was persuaded that they were on the eve of a general adoption of this method of cooking. The thing that gave him the greatest satisfaction was the substantial increase in the use of gas for power purposes; the consumption having doubled during the year. Gas for the production of power was giving the greatest satisfaction throughout the district, and frequently testimony was borne to the Manager in regard to the efficient and easy way in which it was manipulated, and the low initial cost and general charges. The Committee were wise in installing engines on advantageous terms. Having referred to the receipts, Mr. Robinson proceeded to compare the figures in regard to the working with those for the year 1900. He pointed out that at that time 9340 tons of coal were carbonized, and 87,214,000 cubic feet of gas made, or 9276 feet per ton; whereas last year, out of 10,732 tons of coal, 117,015,000 cubic feet of gas had been produced, or 10,903 cubic feet per ton—an increase of 29,801,000 cubic feet, with only 1392 tons of coal extra, and an increase of 1627 cubic feet per ton. The gross profit of £8136 was a record; and it had been disposed of as follows: Interest on loans amounted to £4598, and redemption of loans to £2038, compared with £4537 and £1979. Last year he called these burdens a "monster with a voracious appetite that was never satisfied;" and he could not find a better term now. Interest and redemption charges were not, however, so heavy per 1000 cubic feet as in the preceding year, owing to the increased consumption. In the first year of the Corporation's management, the figure was 1s. 7d.; this time last year it was 1s. 2¾d., and now it was 1s. 2¼d. The capital in the first year stood at 32s. 5d.; last year it was 25s. 2d.; and now it was 22s. 9d. This showed that what the Corporation had added to the capital had been well spent. As an illustration, he might mention that £11,500 had been spent on the mains, and they had saved in leakage 21,544,200 cubic feet of gas, which represented about £3000, or £500 a year on the average; and in the bargain they had new mains instead of defective ones. Of the surplus profit, £1360 had been placed to the retort suspense account, against £1145 before; and this entirely liquidated what had been a great bugbear. They might congratulate themselves on the way in which the liability had been discharged; and they were fully justified in rebuilding the retort-house on modern lines. The total inclusive cost of the works was £114,750; the capital now stood at £120,000; and they had paid off £49,544. This was enormous, and the earning capacity of the works was greater than when the undertaking came into the possession of the Corporation. He should like to see every department in so efficient a condition. He hoped the Corporation would continue the vigorous policy that had made the gas-works what they were; and if they did this, he believed the public would assure them of their continued support.

The motion having been seconded, Alderman Stead said that though Mr. Robinson had remarked that the record of this year was never anticipated when the Council agitated for the purchase of the gas-works, they expected to make as large a profit as from £8000 to £10,000. If not, how could they have said in their speeches that they would be able to light the town free and build a Town Hall? They had done the latter, but it had not been paid for out of the gas profits. He, however, was looking forward to the day when it would be. The time was coming when the Chairman of the Gas Committee and the Manager should cry "Halt." When they considered that they had made upwards of £8000, and had it all swallowed up in expenses, it was time to do this. They had been spending on mains, retort-house, &c., ever since the works were purchased, and were now looking forward to a larger profit. Then there would be something to hand over for the Town Hall or in relief of the rates.

Alderman Townend, referring to these remarks, ventured to suggest that if the Committee cried "Halt," the prosperity of the gas-works would have ceased. In an undertaking of this character, there was no such thing as standing still. They must go forward and keep abreast of the times, or they would certainly retard. As to the spirited policy of the Manager, he concurred with the Chairman of the Committee that it had been the making of the success of the gas-works. He was not at all surprised at that success, and was pleased that the Chairman was such an enthusiast, remembering the time when he was against the undertaking. Credit was due to those who, once opponents of the purchase of the gas undertaking, had done their best to make it a success. He called attention to an application by the stokers for an eight-hour shift, and moved, as an amendment, that it be acceded to. He said that the Chairman of the Committee had given credit to the workers; and his (the speaker's) experience was that the whole of them, from the Manager to the stokers, had done their best. Having so satisfactory a report, it was the least they could do to fall in with the request. By doing so they would do themselves very great credit. In reply to Alderman Wilson, the Manager stated that though it was called a twelve-hour shift, the men actually worked only eight hours. With an eight-hour shift they would be at work 6⅔ hours. Mr. Pinder seconded the amendment, which was supported by Mr. Wilson, a member of the Gas Committee. He said, the Chairman having mentioned that the staff was among the agencies that had made for the success of the gas undertaking, they must admit that everybody must have worked heart and soul; and he contended that all who had contributed to the success should have their share of the credit, financial and otherwise.

The Mayor (Mr. J. T. Marsden) having congratulated the Chairman of the Gas Committee on his able speech and the borough on the success of the gas undertaking, Mr. Robinson said, though he was in accord with the mover of the amendment in regard to principle, he was surprised at its being proposed, as there would be an opportunity of raising the question when the report of the Committee who had the matter under consideration was presented. With regard to the Committee crying "Halt," while he hoped they would keep their eye on the capital expenditure, and not spend more than they were absolutely compelled to do, they could not afford to be parsimonious. They would have to do as all business men did—spend money on their plant and machinery for distribution.

After some further remarks on the subject of a possible reduction in the price of gas, the amendment was defeated; and the minutes of the Committee were approved.

NELSON GAS UNDERTAKING.

The Past Year's Working.

The Gas Engineer and Manager of the Nelson Corporation (Mr. A. J. Hope) has presented to the Gas Committee his report for the year to the 31st of March. It shows that the gross profit was £14,605, and that at the close of the year there was a surplus of £3953 to go to the revenue appropriation account; being £394 more than was estimated. The total wages of the Gas Department for the year amounted to £10,272—viz., £9221 on revenue account, £703 on capital account, and £348 on the carburetted water gas plant account. The total for the previous year was £9096; the other figures being £8841, £219, and £36. The carbonizing wages amounted to £3245; being at the rate of 2s. 4½d. per ton of coal, of which 27,178 tons were carbonized, or 1146 tons more than in the preceding year. The total cost, delivered on the works, was £16,068, or an average of 11s. 9d. per ton, against 10s. 9d. before. The total quantity of gas made was 300,801,000 cubic feet—namely, 162,662,000 cubic feet of coal gas at the Nelson works, and 133,997,000 cubic feet of coal gas and 4,142,000 cubic feet of carburetted water gas at the Brierfield works; being an increase of 23,336,000 cubic feet, or 8·41 per cent., on the total quantity made in 1906-7. The coal gas made per ton of coal carbonized was 10,915 cubic feet, which compares favourably with the make per ton in previous years. The total quantity of gas sent out was 300,931,000 cubic feet—being an increase of 23,767,000 cubic feet, or 8·57 per cent. Of the total output of gas, 89·29 per cent. was sold to private consumers (65·62 per cent. through ordinary and 23·67 per cent. through prepayment meters), 5·42 per cent. was used in the public lamps, 1·18 per cent. for lighting the two gas-works, and 4·11 per cent. was unaccounted for—or 2·45 per cent. less than the average throughout England. There were 12,029 tons of coke, 396,880 gallons of tar, 314 tons of sulphate of ammonia, 533 tons of mortar, and 839 loads of ashes made and sold during the year. The gross income from residuals was £11,819. After deducting the expenditure thereon, the net income was £10,297; giving a net return of 7s. 7d. per ton of coal carbonized, and bringing down the net cost to 4s. 2d. per ton delivered.

SMETHWICK GAS UNDERTAKING.

Annual Report of the Secretary.

The annual report and statement of accounts of the Smethwick Gas Department was issued last Tuesday by the Secretary (Mr. W. J. Sturges). It shows that the total capital expenditure at the close of the financial year, after writing off depreciation to the extent of £5972, stood at £215,543, equivalent to 9s. 10d. per 1000 cubic feet of gas sold, compared with 10s. 6d. at the end of the preceding twelve months. There was again a satisfactory increase in the sales of gas; the total quantity sold and accounted for exceeding that of the year 1906-7 by 23,535,400 cubic feet, or 5·67 per cent. There were 438,651,700 cubic feet of gas sold and accounted for; and the quantity lost by leakage and condensation was 22,647,300 cubic feet, or 4·91 per cent. of the output, against 4·65 per cent. before. The number of ordinary meters in use at the end of the year was 3595, and of prepayment meters 6846; the latter being an increase of 727. The aggregate number of meters of both classes was 10,441, against 9597; and the number of cooking-stoves fixed on hire 1002, or an increase of 40.

The income derived from the sale of gas, after allowing for discounts and adjustments, amounted to £49,783; being £2747 more than in the year 1906-7. The revenue from the sale of residual products showed an increase of £2403, mainly due to coke and breeze, which realized £2001 more, owing to higher prices obtained in the market and to the larger quantity produced. Tar accounted for £241, and ammoniacal liquor for £160, of the additional receipts. The total income from all sources was £66,548, compared with £61,353—an increase of £5195. The total expenditure on the trading account was £46,030, against £41,917, or an advance of £4113. The total expenses of the manufacture of gas, including maintenance and renewals of works and plant, amounted to £35,608, or £2652 more than before, due largely to the additional quantity of coal carbonized, but also, in a measure, to greater expenditure on repairs and renewals. The cost of gas into the holder worked out to 9·962d. per 1000 cubic feet. The quantity of coal carbonized was 37,327 tons, against 35,483 tons in 1906-7; and the gas produced therefrom was 436,740,000 cubic feet, or at the rate of 11,700 cubic feet per ton, against 11,680 cubic feet before. The bulk of coke used in the manufacture of water gas was 380 tons, yielding 24,702,000 cubic feet of gas, or an average of 65,005 cubic feet per ton. The total quantity of gas made, therefore, was 461,442,000 cubic feet—an increase of 26,330,000 cubic feet compared with the year 1906-7.

The gross profit on the year's trading was £20,518, equivalent to 11·226d. per 1000 cubic feet of gas sold, compared with £19,436, or 11·237d. per 1000 cubic feet sold, in the preceding year; being an increase of £1082, and representing a return of 10·35 per cent. on the outstanding capital debt, against 9·75 per cent. before. The net profit for the year amounted to £10,021—an increase of £1060; and it was allocated as follows: Contribution to the general district rate account, £2000; third instalment on account of £5000 promised towards the cost of the Council House, £1000; and placed to the depreciation and suspense fund account, £7021. The balance of net profit to be carried forward is the same as last year—viz., £7108.

MALTA AND MEDITERRANEAN GAS COMPANY, LIMITED.

Increased Dividend—Directors' Remuneration.

The Ordinary General Meeting of this Company was held last Tuesday, at the London Offices, No. 60, Gracechurch Street, E.C.—Colonel JAMES LE GEYT DANIELL in the chair.

The SECRETARY (Mr. A. W. Cooper) having read the notice convening the meeting and the certificate of the Auditors, the Directors' report and the statement of accounts (which were referred to in the "JOURNAL" for the 2nd inst., p. 592) were taken as read.

The CHAIRMAN said that when last the Directors had the pleasure of meeting the shareholders, he prepared them to a certain extent for a falling off in the income from the sale of gas, in consequence of the naval establishments at Malta installing their own electricity, the works for which were just then nearing completion. The result of this, as they would see from the accounts was a falling off in the sales of gas of something like (expressed in sterling) £1420; and such good customers had the naval establishments been, that the loss would have been considerably more, but for the fact that every year the increase in receipts—and last year this had been the case as well—from the private lighting had tended to reduce the amount. It was to the private lighting, as well as to the military lighting to a certain extent, that they could look forward to make good the deficiency. However, after all was said and done, the position in which the Company were left was simply that in which they stood as regarded the sale of gas this time two years ago; and, without wishing to be prophetic, he ventured to think they would recoup themselves in a very reasonable time. On the other side of the account, they found that coal, oil, and coke, had increased by £428 compared with the previous year. This was easily accounted for; and they would all be prepared for the explanation that prices had been higher. The cost of coal was 19s. 5¾d. per ton last year, as against about 17s. 5¼d. in the twelve months before; and oil also cost slightly more. The debenture debt he had spoken to them about, he believed, at the last meeting. Ten years ago, he then said, this debt was close upon £40,000—to be exact, it was £39,700. In a few days the debt, which now stood at £14,500, would be reduced to £10,500, which was a satisfactory feature. The amortizement account, which had done such good service in reference to the debenture debt, now stood at £32,966; and it was equal to, and a little more (by £2000) than was charged to capital outlay in their books as representing the two Sicilian stations, Trapani and Marsala, if they were to lose them at once. And not only this, but since 1897 they would have paid off £29,200 of these debentures. This was a healthy condition of affairs; and it was one that the Directors—assisted, of course, by the shareholders, because they all had to make up this amortizement account—had been working up to year by year. Having now arrived at this satisfactory position, the Directors thought that they not only could, but ought to, revert to the old 6 per cent. dividend. It would be gratifying to the shareholders to know that the total make of gas was 138,642,000 cubic feet, and the make per ton 10,984 feet. Their Engineer at the works, Mr. Wilson, pointed with much satisfaction to the result of the working of the regenerative settings as representing a large saving of expenditure during the eighteen months they had been in operation; and Mr. Reid, in his department, referred with considerable pride to the fact that the unaccounted-for gas had touched the lowest figure in the history of the Company. The General Manager, Mr. Starkey, gave unstinted praise to both these most active assistants of his; but he said nothing about himself, and therefore it was left to the Directors and shareholders to express their appreciation of his services, as well as of the services of those who were assisting him. With regard to the two Sicilian stations, which he had never spoken of very hopefully, there was nothing satisfactory to report in the negotiations for taking over the works at Trapani. Moreover there was an item of £524, in the £563 for law charges, for which Trapani was responsible. This was for costs in connection with the municipal debt and arbitration. They fought the Company as to what should be brought to arbitration, and were beaten. The Directors were assured that the debts were all good; but nevertheless they had thought it wise, under the directions of their Advocate, Signor de Cola Proto, to press their claims home; and, for what it was worth, they had obtained judgment in both these places. From Marsala, which was the smaller of the two stations, they heard of a suggestion to extend the term of the concession under more modified conditions, to which personally he attached very little or no importance whatever, as he did not suppose there was any wish to put up electric works. There was no chance of making money out of gas, and certainly not out of electricity. Their Secretary, Mr. Cooper, had devoted his leave this spring and summer to a visit to the stations, devoting most of the time very properly to Malta; and he reported that everything there was in a very high state of efficiency indeed, and that all was going on remarkably well. The Directors hoped—but it was only a hope, because it was before the Government—that the military authorities would make a contract with the Company for a supply of gas to some of their barracks; but if they did so, it would be on the score of economy. The engineers had the matter before them first, and they always favoured electric lighting. But there was such a vast difference in cost between the two, that the Directors hoped they might possibly before long have some communication from the Government on the subject. He concluded by moving the adoption of the report and accounts.

Mr. STEPHENSON R. CLARKE seconded the resolution; and it was unanimously agreed to without discussion.

On the proposition of the CHAIRMAN, seconded by Mr. A. M. PADDON, dividends were next declared at the rates of 7 per cent. on the first preference shares, 7½ per cent. on the second preference shares, and 6 per cent. on the ordinary shares—deducting the payments made on account.

The retiring Director (Mr. A. W. Oke) was re-elected, on the motion of the CHAIRMAN, seconded by Mr. JOSEPH CASH; and the Auditors (Messrs. R. Hesketh Jones and Thomas Guyatt) were also re-appointed, on the proposition of Mr. CASH, seconded by Mr. F. R. SMITH.

A CONVENIENT HEIGHT.

THE "MAIN" COOKER
CAN BE SUPPLIED ON STAND
AT ANY CONVENIENT HEIGHT
FOR COOKING.

R. & A. MAIN, LTD.,
LONDON GLASGOW. FALKIRK.

Mr. PADDON, in proposing a vote of thanks to the staff, said it was really deserved in an extraordinary measure on this occasion. They all knew the difficulties which must be connected with carrying on the business of a Company having three small stations considerably removed from one another, and the good results achieved were the outcome of the efforts of their officials. The accounts were subject to the difficulties of a rise in the price of coal and oil; and also to the fact that they had not had quite the same increase at Malta as usual. But any decrease they had experienced at Malta had been practically confined to the supply of gas under contract; and this was very different from a diminution in the supply to private consumers. The latter paid the full price; but public authorities, for some reason or another—he did not know what it was—always got their gas at some rate to which they were not really entitled.

Mr. A. F. PHILLIPS seconded the motion, which was heartily agreed to.

Mr. COOPER, in returning thanks on behalf of the staff here and abroad, said he had recently visited all the stations, and was very pleased to notice at Malta the *esprit de corps* existing between the three chief officers—Mr. Starkey (the general representative of the Company), Mr. Wilson (the head of the manufacturing department), and Mr. Reid (who supervised the distribution). They seemed to have in their hands entire grasp of the different departments; and they worked heart and soul in the interests of the Company. As regarded Trapani and Marsala, they were very poor stations; but the Company were represented well there by Mr. Merino, who had been for many years a zealous servant of the Company, and by Mr. Torrini, who was also an old servant.

An Extraordinary General Meeting was then held, at which

The CHAIRMAN moved a resolution to cancel Article No. 72 of the Articles of Association and to substitute for it a fresh article. The article to be rescinded reads: "The annual sum of £500 shall be granted to the Directors out of the income of the Company as a recompense for their trouble in the management of the affairs thereof, and in the event of the dividend at any time declared on the ordinary capital stock of the Company exceeding 6 per cent., the Directors shall be entitled to receive out of the income of the Company an increased remuneration of £100 for each 1 per cent. of dividend declared exceeding 6 per cent., and such several amounts shall be divided among them as they may determine. If at any time hereafter the number of Directors shall be increased beyond the present number of four, the Directors shall be entitled to a proportionate increase in their remuneration, and may take the same accordingly." The article to be substituted reads: "That the remuneration of the Directors shall consist of such an annual sum as the shareholders may determine at any meeting of the said shareholders, in the convening of which notice shall have been given of the intended submission of any resolution with respect to the said remuneration."

Mr. SMITH seconded, and said he felt the Company had now passed through their difficult time. They had for many years had 5 per cent., which was a very wise step to take, while the amortizement account was being made up. Now it was decided that they should have 6 per cent.; and as the Directors had done so well, the least the shareholders could do was to pass this resolution, the effect of which would be to give the Board something more for their time and trouble. They had experts on the Board; and considering that they had no Consulting Engineer to employ, they should take care to make the remuneration of the Directors adequate.

The resolution was carried unanimously; and a vote of thanks was accorded to the Directors, on the motion of Mr. WILKINS, seconded by Mr. WESTBROOK.

LYTTELTON (N.Z.) GAS AND WATER SUPPLY.

We have received from Mr. G. A. Lewin, the Town Clerk of Lyttelton (N.Z.), his report to the Mayor and Corporation on the more important transactions of the Municipal Council for the year ending the 31st of March. In the course of it, the following information is furnished in regard to the gas and water supply of the borough.

Mr. Lewin states that the production of gas was well maintained throughout the period covered by his report; but that the total, compared with the preceding twelve months, showed very little improvement. There is, however, now a steady demand for services; and the position of the undertaking is stated to be such that no apprehension need be felt for its continued success, provided the policy of the past is adhered to. The cause of the slight improvement is not far to seek; and Mr. Lewin says it tends to emphasize the doubtful advantage of depending on a small number of large consumers in contradistinction to a large number, each using a moderate quantity of gas. One consumer at Lyttelton takes 10 per cent. of the entire output of gas. The net profit for the year was £894, or a few pounds more than the previous results; and Mr. Lewin thinks that, all things considered, the year must be regarded as entirely satisfactory. During the five years and four months, since the municipalization of the works, the undertaking has paid its way, and in addition has produced sufficient surplus to vote £1110 to the sinking fund, and £2324 for extensions of works, give the consumers rebates by way of reductions in price equal to £1000 per year, and provide £500 in relief of the rates. Mr. Lewin thinks the result will bear comparison with that realized by any other gas undertaking similarly situated, for in the acquisition of the gas-works a fairly high price was paid for goodwill. In five years the price has been reduced from 10s. to 6s. 8d. per 1000 cubic feet for lighting, and to 5s. 10d. for cooking and heating—figures which it is believed will bear comparison with places in the Dominion where the output of gas is two or three times as great as at Lyttelton. The working results reflect great credit upon the Manager (Mr. W. M'Auliffe). The quantity of gas produced was 9,434,000 cubic feet, or at the rate of 11,690 cubic feet per ton of coal carbonized; 8,570,800 cubic feet were sold;

"VOLCANIC" (Powder). "VOLCUM" (Paste).

Andrew Stephenson,

Tel. Address:
"VOLCANISM, LONDON."

182, Palmerston House,
Old Broad Street,
LONDON, E.C.

LEST YE FORGET.

and 95·5 per cent. of the make of gas was accounted for. The coke sold per ton of coal was 8·77 cwt.; and out of the 10,006 gallons of tar made (12·4 gallons per ton of coal) 9730 gallons were sold. The following figures are based upon the quantity of gas sold: Revenue, 8s. 8·83d.; expenditure, 6s. 10·77d.; profit, 1s. 10·06d., or about £787 on the sale. Adding the profit on fittings and incidentals, £107, the net profit for the year is, as stated above, £894.

In the Water Department, Mr. Lewin says the supply was for the second time taxed to its utmost capacity, owing to severe drought. The Council were, however, able to meet all the demands. Among the outstanding incidents of the year was the acceptance of a tender for a new power plant, consisting of a suction gas-producer with high-lift turbine pumps, for £2500; and the saving in fuel is expected not only to pay the interest on this amount, but also on the expenditure on the new building to house the plant, and leave a margin. A 3-inch cast-iron pipe was taken up, and a 6-inch spiral steel one substituted for it. The smaller pipe, though perfectly sound, was so badly incrusted as to reduce its effective discharge to that of a clean 2-inch pipe. The returns of water pumped indicate clearly how the demand is growing. The daily average consumption rose from 27·23 gallons in May to 39·70 gallons in January; while the mean for the whole year was 32·19 gallons, against 29·65 gallons the preceding twelve months. The total quantity of water pumped into the main reservoir during the year was 56,094,000 gallons, compared with 52,483,000 gallons before. Of the first-named quantity, 47,116,830 gallons were consumed in the town and 8,977,200 gallons were supplied to shipping.

YORK ELECTRICITY UNDERTAKING FINANCES.

Gas v. Electricity for Public Lighting.

The inquiry by Mr. H. R. Hooper, of the Local Government Board, into the finances of the York electricity undertaking, which was commenced in April (*ante*, p. 177) and adjourned, was resumed recently. The inquiry arose out of an application by the City Council for sanction to borrow £31,604, part of which amount (£24,404) had been already spent without previous sanction. The hearing was adjourned in order that a quantity of information might be procured and placed before the Inspector.

When the proceedings were resumed, Mr. Bairstow appeared for the York Gas Company, and said he was present to give the Inspector some particulars for which he asked on the previous occasion. The Company were in a position, he remarked, to give a comparative statement as to the cost of public lighting with electricity and with gas. They did not wish to interfere with the policy of the Corporation at all; they quite recognized that it was for them to determine how they should light the city. But seeing that the Local Government Board were anxious for information as to the cost of lighting, the Gas Company, as large ratepayers, were there to furnish it. Mr. J. W. Davison, the City Treasurer, said the amount paid to the Electricity Committee for public lighting was £1571 per annum; while the total cost of the public lighting was £5000 a year. Mr. Bairstow remarked that 135 electric lamps had been substituted for gas-lamps, and the annual cost had been £1498. He suggested that they were substituted for 248 incandescent gas-lamps, and that these cost the city £764. The electric lighting represented one-eighth of the whole public lighting of the city; while the cost of it was one-fourth of the total cost. Therefore, if the whole of the public lighting of the city were converted from gas to electricity, it would double the cost to the ratepayers. Alderman Meyer (the Chairman of the Electricity Committee) urged that lighting by electricity was greater and more efficient.

At the request of Mr. Bairstow, Mr. J. H. Hill, the Manager and Secretary of the Gas Company, was permitted to furnish testimony as to the relative cost of gas and electricity. Mr. Hill handed the Inspector the following statement:—

Gas and Electric Lamps Compared.

GAS.—No. 3 Kern, incandescent—	
The annual charge for a No. 3 Kern incandescent lamp (the kind generally used in street lighting) is	£2 11s. 9d.
Maximum candle power	100 candles.
Average number of hours each lamp burns per annum	3443½
Number of candle-hours of light per annum	344,325
Cost per 1000-candle hours of light	1·803d.
ELECTRIC.—Osram lamps, newest kind of lamp used for street lighting—	
The annual charge for an electric incandescent Osram lamp, consisting of two bulbs, as fixed in Scarcroft Road and Bishopthorpe Road is	£2 17s. 0d.
The maximum candle power as marked on the lamps (32 each bulb) is	64 candles.
Taking the average of hours each lamp burns to be the same as the gas-lamps	3443½
The number of candle-hours of light per annum is	220,368
Cost per 1000 candle-hours of light	3·104d.
Extra cost per 1000 candle-hours of electric light above the cost per 1000 candle-hours of gas light	1·301d.

This is equal to a 72 per cent. increase in cost (light for light).

Alderman Meyer asked if Mr. Hill could say what was the charge for gas and what was the charge for service. Mr. Bairstow: Will that be of any assistance? The Inspector: I do not know that it would be fair to ask a trading company to give the information. Mr. Bairstow: I must protest against the Chairman's attitude. He forgets that we are large ratepayers; and it is not encouraging to ratepayers to find the Chairman of an important Committee adopting such an attitude. It is difficult to avoid treading on people's toes on these occasions. Alderman Meyer: You are not treading on my toes. Mr. J. W. Hame

THE COOLEST WAY—

and most effective—of obtaining hot water in any part of a house or building is by the use of our

"SUN" Automatic HIGH-PRESSURE BOILER

Fitted with Patent Heat Regulator,

which automatically regulates the supply of Gas as the temperature of the Water varies from the desired limit.

The 20 Gallons of Water at 100° Fahr. contained in the Boiler is sufficient for Two Baths, and as the Gas supply is Automatically increased the moment any Water is drawn off, a supply for future requirements is promptly and rapidly heated.

JOHN WRIGHT & CO.,
ASTON,
BIRMINGHAM.

(the Electrical Engineer) submitted that, according to the figures of Mr. Hill, the price of the gas must be about 4½d. per 1000 cubic feet. Mr. Hill: No. Mr. Hame: It is less than 6d. Mr. Leaf (a Director of the Gas Company): It is nothing like that. It is four times as much. Replying to a question by Mr. Bairstow, Mr. Hill said the Gas Company paid £2850 per annum in rates. Alderman Meyer raised the question of the times of lighting the lamps; and Mr. Hill stated that the Company were given 1 hour and 20 minutes after sunset in which to complete the lighting. Alderman Meyer said in the part of the city in which he resided it was sometimes 10 o'clock before the lamps were lit. Mr. Hill replied that in the month of June the period in which the lamps could be lit did not expire until after that hour. Alderman Meyer said the Corporation were being challenged with supplanting gas with electricity; and he wished the Inspector to note that some of the gas-lamps were lit very late. Electricity was much quicker. There was a period of the evening known as "blind man's holiday"—the period between sunset and the lighting of the gas-lamps. An application had been made to the Gas Company to light the lamps earlier. The reply was that time must be allowed for lighting, unless the price were increased. Mr. Hill: Hardly that. We gave a price which, compared with the cost of electricity, was a "mere fleabite." An offer was made recently on similar lines. We can light the city earlier, of course, at a charge. Counsel and the representatives of the Gas Company then withdrew.

The Inspector next dealt with the general application. The City Treasurer stated that the total capital expenditure on the works so far amounted to £125,254. Details were presented of previous expenditure under sanctioned loans; and, during the analysis of the figures, the Inspector pointed out that in 1903 an inquiry was held into an application to borrow £7500 for the purpose of extending the electricity works. The estimates for the £7500 had been abandoned by the City Council twelve months before. New estimates, showing that the cost would be £20,000, had been prepared; yet the application went forward to the Board for £7500. The actual cost was about £17,500. Mr. Hame said that the estimate for £7500 was made by the late Electrical Engineer, and that for £20,000 by the late City Engineer. The Inspector subsequently elicited the fact that since 1903 the Town Clerk, the City Surveyor, the Electrical Engineer, and the Chairman of the Electric Lighting Committee had all been changed, and said that perhaps this was the explanation, if there could be any explanation. At any rate, it seemed a most extraordinary policy. After examining the particulars of expenditure for a series of years, the Inspector inquired if the Corporation would care to adopt the alternative of asking for the money for a much shorter period, and not attempting to explain. This course had been followed where it was found impossible to explain; and the period had then varied between five and twelve years. There was no answer to the question; and the Inspector pointed out that four years' sinking fund was due on over £20,000, which would mean quite £3000. The capital expenditure was already so high, and had been going on for eight years, that it was necessary for him to see that it was kept down, and that no items applied for now were other than those properly chargeable to capital. Mr. Hame urged that it was to the credit of the Committee that they had something in the way of buildings and machinery to meet future requirements. The Inspector: But you have no reserve fund. Is your plant such as you would put down at the present day? It has been put in with a view to tramways; and you have not even statutory powers to do it. It is surely speculative. The machinery put in was not the best for the undertaking, and is not the best to-day. It was unnecessary at the time, and is to-day inconvenient and uneconomical. Is it not a handicap on the work of the undertaking to have such machinery for a light load? In order to understand the position, one must recognize facts. Mr. Hame: What you say is quite right; but side by side with it must be taken the fact that there are buildings provided for further extensions, and that we contribute to the sinking fund on plant and buildings not yet brought into use. Therefore they will be paid for earlier than they otherwise would have been. The Inspector: If you were to put in a plant to-day—turbines, for instance—would you want buildings of the height and width of these? Mr. Hame: Certainly not, if turbines were put in; but it is not certain that turbines would be put in. The Inspector: Is it not better to wait and see? Would it not have been wiser to wait? Mr. Hame: That is so. The Inspector: Meanwhile, the undertaking is losing money, and is heavily handicapped. At any rate, one can see that there has been a very large sum of money expended prior to the necessity for doing anything. Mr. Hame: Undoubtedly. The Inspector said it was no wonder they were in a difficult position; but it seemed quite clear that all the capital expenditure had been incurred before Mr. Hame came. He would like to make that quite clear to the public.

When the proceedings were resumed the following morning, the Inspector went at length into the details of the application, and reduced several of the items. Mr. Hame stated that the average cost per unit sold was 2·51d., made up of 1·07d. works cost and 1·44d. capital charges. The gross revenue for the year ending March 31 last was £15,824, an increase of £2000 on the previous year. There was no depreciation fund. The Inspector drew attention to the debit balance of £4927 that had been carried forward, and asked if this represented accumulated debit balances from the commencement. The City Treasurer stated that the results of the working of the concern in the years since 1901 had been as follows: 1901, surplus £409; 1902, surplus £350; 1903, loss £800; 1904, surplus £351; 1905, loss £2946; 1906, loss £2267; 1907, loss £618; 1908, loss £19. A portion of the accumulated deficit, representing the alterations to the offices, had been paid for out of rates; and this left a total debit balance of £4927. The Inspector: What are the requirements of the Order with reference to debit balances? The Town Clerk: Under the York Order of 1890, section 52 provides: "Any deficiency in income in any year shall be chargeable upon and payable out of the local rates." The Inspector: That has not been complied with. Mr. Hame remarked that the Committee had been in a difficulty, as the Order did not specifically state that a deficit should be made up out of the current year's rates. The inquiry was then adjourned *sine die*.

A Gas Cooker without SCREWS!

It is a fact that **not a single Screw is used** in the construction of the body of the "NEW DAVIS" Cooker.

Consider what this means from a MAINTENANCE point of view.

The Labour involved in taking a "NEW DAVIS" Cooker apart is practically nil.

The entire absence of Screws is a feature never before attempted in Gas Cooker construction.

The idea is entirely original and the advantages it gives are incalculable.

We are anxious that you should make the closest scrutiny of the SCREWLESS COOKER.

May we send you a Sample?

DAVIS—the Gas Stove People.

Camberwell, London, S.E.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The annual excursion of the Scottish Junior Gas Association—Eastern District—was held to-day, to East Wemyss. About twenty members were present. At Wemyss they were received by Mr. Davidson, Secretary of the local Gas Company, and Mr. Gourlay, the Manager. After seeing over the gas-works, the party dined in the Randolph Hotel. Sports were then indulged in, and a visit was paid to Methil Docks, where there is an extensive coal-handling plant. The weather was fine, and a pleasant afternoon was spent.

The opening of the new gas-works at Kirkintilloch on Wednesday was a very quiet affair, consequent upon the heavy drain that there was upon gas managers, even in these northern parts, to attend the meeting of the Institution in London. Mr. W. Wilson, of Falkirk, who initiated the works, was present, and about the only other managers I met with were Messrs. W. Ewing, of Greenock; J. Webster, of Provan; A. MacLeod, of Dawsholm; and A. Smith, of Tradeston. The Contractors were represented by Messrs. F. Brockway, of Messrs. R. Dempster and Sons; Mr. G. R. Nelson, of Glasgow, as representing Messrs. George Waller and Son; and Mr. J. D. Gibson, of Glasgow, for Messrs. Clapham Bros. The opening ceremony consisted of turning on one of the duplicate exhausters, provided by Messrs. Waller; and the company then had a look at the works, which were in full summer operation. In appearance, the contrast between them and the old works is most marked. The Corporation of Kirkintilloch have been noted for the supply of cheap gas, which is doubtless due to the proximity of suitable coal, and to the writing-down of the capital account; but, of course, the excellence of the management must not be left out of account. The conditions of service in the old works must have made it difficult to keep down the price. Now, when the drawbacks have been removed, we may look for even a better record in the future.

The annual meeting of the Dundee Town Council as Gas Commissioners for fixing the price of gas and adjusting the estimates for the year was held on Wednesday. Treasurer Urquhart said that the Manager had provided for an increase in the consumption of gas by 30 million cubic feet for the current year, and he had contracted for coal at an average of 1s. 2d. per ton less than last year. Provision was also made for the maintenance of the works out of revenue; and it was well to note that during the past three years there had been nothing added to capital account in respect to the upkeep of the works. The capital per million cubic feet of gas delivered was £442, as contrasted with £1278 in 1870. The latter was really the price at which they purchased the works, so that it would be at once seen that real progress had been made in bringing them into a most excellent condition, especially when it was considered that £1000 per million cubic feet was regarded as a satisfactory figure. In other words, if any enterprising company made an offer for the works, and the Council were willing to sell, in all likelihood they would be offered not less than twice the sum at which the value stood in their books. This, he thought, was a sufficient answer to the statements which were made from time to time as to the frightfully bankrupt state of their works. It was also said that they did not have any real valuation of their works, and that they did not write down the valuation year by year, as would be done in an ordinary business. But it was well to bear in mind that the true valuation of the gas-works was based on the output—on the capabilities of the concern; and valuing their undertaking on this footing they were in a more than satisfactory condition. During the past three years they had reduced the capital debt by something like £25,000. The Treasurer concluded by paying a tribute to the great assiduity and care which Mr. G. Stevenson, the Convener of the Gas Committee, devoted to the department, and to Mr. A. Yuill, in whom, he said, they had an energetic, able, and devoted Manager. Lord Provost Longair considered that it would be gratifying to the whole community that the price of gas had reached the low figure of 2s. 4d. per 1000 cubic feet. Not many years ago most of them were persuaded that their gas-works were in a very bad state indeed. But these conditions had all been changed for the better; and he questioned if they had a better municipal asset than their gas undertaking. It was a curious circumstance that not long ago they thought gas was to be superseded by electricity, and yet the consumption was continually growing. Mr. Stevenson said that the consumption of gas had increased during the past year by 66 million cubic feet—almost a record increase; and it was this which to a large extent determined the price. As they knew, interest, annuities, sinking fund, and feu-duties were fixed charges which had to be paid whether the consumption were large or small; so that the increase during the past year had very materially helped to produce the financial position they were in. It would be a wise thing for factors, architects, and house proprietors to take into account that the consumption of gas was likely to go on growing, because sometimes there were complaints that they could not get enough pressure. This arose from deficient gas-fittings, and therefore every landlord and every tenant should see to it that the gas-fittings were sufficient to give the light required. Contrasting their position with that of other towns, and especially with that of Glasgow, he was glad to say they were getting into line, and were able to sell gas at about the same price as they did in that large city, which was much nearer the coalfields. The average price of their coal during the past three or four years was 10s. 7d. per ton, as against 12s. 5d. per ton at present, which was 1s. 8d. more than the average of the preceding four years. They might reasonably expect that future prices would more nearly approximate to 10s. 7d.; so that ere another year had passed they might hope to be in an even better position. The Council adopted the estimates; and, on the motion of the Lord Provost, Treasurer Urquhart was heartily thanked for his labours.

In the Edinburgh Town Council on Tuesday, a long discussion took place on a recommendation by the Lord Provost's Committee that a clause be inserted in the Provisional Order of the Gas Commissioners to the effect that gas be delivered at the City Chambers at a minimum of 16 candle power, and that there be an official testing

Sawer & Purves,

MAKERS OF

COIN COLLECTING CONVEYANCES.

PAINTED AND LETTERED AS REQUIRED.

OVER 100 IN USE.

REDUCED PRICES.

EXCELLENT FINISH.

EXTRA STRONG WHEELS.

FULL PARTICULARS ON APPLICATION.

"THE MODEL COIN COLLECTOR."

MILES PLATTING, MANCHESTER. | RADFORD ROAD, NOTTINGHAM. | *Scotch Agent:* JNO. D. GIBSON, 93, Hope Street, GLASGOW.

place in the City Chambers. Bailie Maxton moved, as an amendment, that, in view of amendments agreed to by the Gas Commissioners, the Council withdraw opposition to the measure. An amendment was also proposed that the candle power remain as at present. On a division, it was agreed to approve of the reduced candle power. It was resolved that the testing-place should be at the City Chambers.

The fiftieth annual meeting of the Dalbeattie Gas Company, Limited, was held on Friday of last week. The Directors recommended a dividend of 6 per cent., which, it was observed, was a very satisfactory celebration of the jubilee of the Company.

It was reported to the Dunfermline Town Council this week that the quantity of gas made during the year amounted to 117,500,000 cubic feet—a decrease upon the preceding year of 1,129,600 cubic feet. The gas sold amounted to 111,678,300 cubic feet—a decrease of 1,212,900 cubic feet, equal to 1·07 per cent. The Gas Committee had had under consideration the advisability of entering into contracts for the supply of coal to the gas-works; but they reported that after discussion they had agreed that, in view of the present and likely state of the market, the Gas Manager should be instructed in the meantime to buy coal as required. This was agreed to by the Council.

A minute of a Special Committee submitted to the Falkirk Town Council this week stated that there had been read to the Committee a report by the Lighting Inspector, dated June 11, from which it appeared that the gas consumed per lamp fitted with upright incandescent burners was 3350 cubic feet per quarter; while the consumption in lamps fitted with inverted burners was 1650 cubic feet. Consideration of the report was delayed until the consumption of gas by the different kinds of burners has been tested by the Gas Manager.

The Earlston Gas Company, Limited, are this year paying a dividend of 3s. per £5 share. The Inverurie Gas Company, Limited, have paid a dividend at the rate of 6½ per cent., and reduced the price of gas from 7s. 1d. to 6s. 4d. per 1000 cubic feet.

At the present time the community of Lochmaben are interesting themselves in the matter of public lighting; the question which they have before them being whether they should go on with a scheme for the lighting of the town by electricity, or should take over the undertaking of the Lochmaben Gas Company, Limited. At the last meeting of the Town Council, the proposal was made that a public meeting be held, at which the ratepayers could express their opinions as to the two schemes; but the Council rejected the proposal. A letter from the Secretary to the Gas Company was submitted, intimating that the Directors were prepared to recommend to the shareholders to offer the whole works to the Council at the price of £450. A motion was made that £400 be offered; and this was supported by a majority of the Council, who rejected a proposal that no further action be taken in the matter. In a second letter from the Secretary, it was intimated that the Directors considered that the offer of £400 was inadequate, and that the price would require to be fixed by arbitration. Then the Town Clerk submitted a report which Mr. W. B. M'Lusky had drawn up at the request of the Council, as to the cost of new gas plant and buildings. These Mr. M'Lusky estimated to cost £2330. The Council resolved to intimate to Mr. M'Lusky that they had agreed to depart from the question meantime.

The annual two-days' inspection of the city water-works by the Corporation of Glasgow took place on Thursday and Friday. An interesting note, prepared by Mr. J. R. Sutherland, the Water Engineer, was handed to each of the Councillors. In this it was stated that the old aqueduct from Loch Katrine to Milngavie had been in continuous use for practically fifty years. During most of this time it was the sole means of conveying water to the city, and it was only on rare occasions that a stoppage of the flow for a few days could be allowed for attending to repairs of the most urgent nature. The new aqueduct being now in full operation, it became possible to thoroughly overhaul the old one in many places at which there had been serious falls of rock. For the most part, the note stated, there was no pavement in the bottom, and the original rock floor contained many large holes and the aqueduct was seriously encumbered with *débris* in a few places. The roof and bottom were out of their true level; thus somewhat retarding the flow of the water. These defects are being made good by the workmen of the Water Department lining and arching the old tunnel with concrete at all places where the rock appears unstable or liable to wastage, and by providing a concrete pavement throughout. This work has been going on for about four years, and is finished to the extent of about two-thirds of the whole amount required. About £45,000 has been expended on the work, which is estimated to cost altogether about £70,000.

Charge for Water Supplied to Unoccupied Premises.—At the meeting of the Metropolitan Water Board last Friday, the Appeal and Assessment Committee reported that they had had under consideration representations made by the Incorporated Association for the Protection of Property Owners, Limited, with reference to allowances in respect of domestic premises during periods of non-occupation. The practice had varied considerably in the different districts, and the chief object was to secure uniformity. The present law provided (Water-Works Clauses Act, 1847, section 71) that an occupier who gave notice of his intention to discontinue the use of the water, or who removed from his dwelling between any two quarter-days of payment, should pay the water-rate in full for the entire quarter in which he quitted the premises or gave notice to discontinue the supply. This the Committee regarded as somewhat of a hardship, especially in the case of owners of property let on weekly or monthly tenancies; but they said it must be borne in mind that the Board were at some expense in maintaining a supply of water available for the premises, even though they were unlet. From figures which had been submitted to them, they believed that an allowance of 75 per cent. during the actual periods of non-occupation would maintain the present financial position, and establish uniformity of practice with regard to water-rates payable by owners. They were of opinion that the matter should be adjusted on this basis, and were pleased to learn that the Finance Committee concurred. They recommended accordingly, and their proposal was adopted.

CLARK'S PATENT
"SYPHON."

THE STOVES FOR HIRE.

ALWAYS RELIABLE . .
EASY TO WORK . . .
EASY TO FIX'. . . . .
CONSUMERS ALWAYS SATISFIED. . . . . .

S. CLARK & CO.,
Compton Works, Canonbury Road,
HIGHBURY, LONDON, N.
Show-Rooms: 58, HOLBORN VIADUCT, E.C.
Telegrams: "SYPHON STOVES LONDON."
Telephone: No. 1777 North.

CURRENT SALES OF GAS PRODUCTS.

Sulphate of Ammonia. LIVERPOOL, *June* 20.

The market continues to drag, and there has been no check to the downward movement in prices which commenced in the second half of May. Orders are extremely scarce, and current production is difficult to dispose of; so that the closing quotations have become £11 12s. 6d. to £11 15s. per ton f.o.b. Hull, £11 15s. to £11 17s. 6d. per ton f.o.b. Liverpool, and £12 per ton f.o.b. Leith. There has been good inquiry for delivery up to the end of the year, and for October-March; but buyers' ideas are scarcely above spot values, and very little first-hand business has been done, makers for the most part refusing to make the concession required.

Nitrate of Soda.

This article is also weak in all positions, and spot prices are 9s. 9d. and 10s. per cwt. for 95 per cent. and refined qualities respectively.

Tar Products. LONDON, *June* 22.

The markets for tar products are without alteration of importance. Pitch remains weak, and business is stated to have been done on the Continent for prompt delivery at equal to 18s. per ton east coast; while in Manchester some quantity was sold for delivery this month at 17s. 6d. For forward delivery, Continental consumers report having purchased a fair amount for January-June at a price which is very little in advance of those ruling for prompt delivery to-day. Creosote is steady without any alteration in price. Benzol, 90 per cent., is quiet, London manufacturers have endeavoured to sell at 8d. without success; while in the North 7¼d. has been accepted. Fifty-ninety benzol and toluol are both unchanged, and there is not much demand for either article. Solvent naphtha is steady; but prices remain unaltered. High-flash naphtha is quiet, and difficult of sale. Carbolic acid is weak. Considerable difficulty is experienced in obtaining satisfactory offers for prompt delivery; while the price indicated by Continental consumers for September-December offers no inducement to dealers at present. Refined naphthalene maintains its price; while crude is rather firm, owing to the better outlook for creosote.

The average values during the week were: Tar, 11s. 6d. to 15s. 6d., *ex* works. Pitch, London, 19s. 6d. to 20s.; east coast, 18s. to 18s. 6d.; west coast, 17s. 6d. to 18s. 6d., f.a.s. Benzol, 90 per cent., casks included, London 7¾d. to 8d., North 7¼d. to 7½d.; 50-90 per cent., casks included, London 7¾d., North 7d. to 7¼d. Toluol, casks included, London 8d., North 7½d. to 7¾d. Crude naphtha, in bulk, London 3½d. to 3⅝d., North 3¼d. to 3⅜d.; solvent naphtha, casks included, London 10d. to 10¼d., North 9d. to 9½d.; heavy naphtha, casks included, London 9⅜d. to 10¼d., North 8¾d. to 9¼d. Creosote, in bulk, London 2⅜d. to 2½d., North 2¼d. Heavy oils, in bulk, 2¾d. Carbolic acid, 60 per cent., casks included, east coast 1s. 5½d. to 1s. 6d., west coast 1s. 5d. to 1s. 5½d. Naphthalene, £4 10s. to £8 10s.; salts, 35s., packages included and f.o.b. Anthracene, "A" quality, 1⅛d. to 1¾d. per unit, packages included and delivered.

Sulphate of Ammonia.

The market for this article is weak, and business is very difficult to negotiate for either prompt or forward delivery. In London, the principal Gas Companies still quote £12 2s. 6d., but probably have very little to sell. The outside makes can be secured upon Beckton terms at about £11 12s. 6d., while f.o.b. London has been done at £11 15s. In Hull, the market is about £11 12s. 6d. to £11 15s.; and in Liverpool about £11 15s. to £11 16s. 3d. In Leith, the price asked by makers is unobtainable; and it is doubtful whether anything over £11 17s. 6d. can be secured. No quotations have been recorded at more than £12.

COAL TRADE REPORTS.

Lancashire Coal Trade.

House coal being now only required in the barest quantities, steam coal and fuel for export, including the supplies which steam vessels must have, form the basis of the demand on the local market. Prices are as follows, and may be said to have been the current rates for the last eight months: Best house coal 15s. to 16s. 6d., secondary 14s. to 15s., common 12s. to 13s. 6d., burgy 10s. 6d. to 11s 4d., best slack 9s. 6d. to 10s. 4d., medium 8s. 6d. to 9s., lower qualities, 7s. 9d. to 8s. 4d., coal for shipping, 13s. to 14s. 6d. f.o.b. at Garston, furnace coke 18s. to 24s. per ton. Miners' wages having been raised 15 per cent. during 1907, and the men believing that it is to their interest and to the interest of their employers to bring no more coal to the surface than will secure them their full wages, rest content at that; and so the stationary condition of the market is maintained. Very hard attempts are being made on the part of the Railway Companies, the largest gas manufacturers, and mill and workshop proprietors to bring down prices of coal, but hitherto it has only been partially successful.

Northern Coal Trade.

There has been considerable irregularity in the coal trade, and local holidays this week will continue it; but the tendency of prices has, on the whole, been downwards—this being a period of low consumption of some kinds of coal. In the steam coal trade, best Northumbrians are lower—at, perhaps, 13s. 4½d. to 13s. 6d. per ton f.o.b. Second-class steams are from 11s. 6d. to 12s. 3d. per ton, and steam smalls are from about 5s. 6d. to 7s. Before the local holidays, coal is usually largely produced, so that supplies are plentiful. In the gas coal trade, the local consumption is now at its lowest, but the exports show a satisfactory increase. Durham gas coals now vary in price for ordinary kinds from 10s. 3d. to 11s. 3d. per ton f.o.b.; and "Wear specials" are easier at 12s. In contracts, there has been allotted that, for some 40,000 tons, for Trieste, at prices varying from 10s. 1½d. to 10s. 5d. per ton f.o.b., and some others in smaller lots, at prices that are not much different. The Rochester contract, for some 48,000 tons for twelve months, has gone to collieries in south-east Durham, at

Richmond's

Saint Helens

Gas Iron.

Economic Laundry, Old Road,
Ashton-in-Makerfield,
18/5/08.

"We are highly pleased with the Gas Iron for Laundry."

"Sorry we did not know about them before, as they would have saved us much labour and money. Will you please send one more set."

Price - - 10s. 6d.

Complete with Two Irons and Stand.

ADVERTISEMENT OF THE RICHMOND GAS STOVE & METER CO., LTD.
London Offices and Show-Rooms: 132, QUEEN VICTORIA STREET, E.C.
General Offices and Works: WARRINGTON, &c.